Square D® SEPAM™ Digital Relay Catalog

Square D
Electrical
Protection
And
Monitoring

a brand of Schneider Electric

SQUARE D

HAZARD CATEGORIES AND SPECIAL SYMBOLS

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service or maintain it. The following special messages may appear throughout this bulletin or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of either symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, **can result in** death or serious injury.

⚠CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, **can result in** minor or moderate injury.

CAUTION

CAUTION, used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, **can result in** property damage.

Note: Provides additional information to clarify or simplify a procedure.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

FCC NOTICE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense. This Class A digital apparatus complies with Canadian ICES-003.

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3 Sepam™ Series 80

4 Additional Modules and Accessories

5 Ordering Sepam Relays

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Sepam Series 40
Sepam Series 80

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Sepam for Greater Simplicity

PE50478

Sepam, a consistent range of protection relays.

A consistent range of protection relays

The Sepam range of protection relays is designed for all protection applications on medium-voltage commercial and industrial distribution networks.

There are three series of relays:
- Sepam Series 20 for common applications
- Sepam Series 40 for demanding applications
- Sepam Series 80 for custom applications

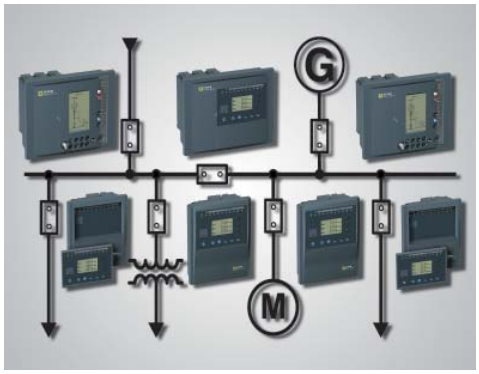
PE50539

Integral equipment control by Sepam.

A multi-functional range of digital relays

Each Sepam series offers all the functions required for the intended application:
- effective protection of life and property
- accurate measurements and detailed diagnosis
- integral equipment control
- local or remote indications and operation

PE50480



A Sepam solution for every application.

A Sepam solution for every application

For each electrotechnical application, Sepam offers the relay suited to the protection needs of your electrical network.

The Sepam range covers the following applications:
- substations (main or feeder type)
- transformers
- motors
- generators
- buses
- capacitors

Sepam Network Protection for Your Peace of Mind

PE50528

Schneider Electric, by your side in over 130 countries.

Schneider Electric's global product line

World leader in Power & Control

The future will call increasingly on electricity with growing needs for new modes of production and new applications. The world leader in electric distribution and automation & control, Schneider Electric makes electricity safe, as well as facilitating and improving its use.

World-wide presence

With sites on every continent, Schneider Electric contributes to customer performance through its unique selection of products, solutions and services, as well as its dynamic policy of innovation.

Continuous, worldwide availability

With over 5000 points of sale in 130 countries, you can be sure to find the range of products that meets your needs and complies perfectly with local standards.

Technical assistance around the globe

Our technicians are always on hand to provide solutions tailored to your needs. Schneider Electric provides all the technical assistance you require, wherever you may be. Visit the www.powerlogic.com site to find contact information about Schneider Electric in your country.

PE50529

Schneider Electric's manufacturing of protection relays

Sepam, over 25 years of experience

Schneider Electric broke new ground in 1982 by marketing the first multi-functional digital protection relay, the Sepam 10.

Today, with the Sepam range, you benefit from more than 25 years of experience on the part of our R&D teams.

Installed base

- 200,000 Sepam relays in over 90 countries
- presence in every sector of activity:
  - energy: production and distribution
  - infrastructures: airports, tunnels, public transport, water treatment
  - industry: automobiles, mines, semi-conductors, metallurgy, petrochemicals
  - commercial sector: shopping centers, hospitals.

Sepam's guaranteed quality

Protection relays must be totally reliable. That level of reliability is obtained by total quality at every step, from design through operation.

- design based on dependability studies and complying with the functional requirements of standard IEC 61508
- development and production certified ISO 9001
- environment-friendly production, certified ISO 14001
- service quality ensured by decentralized logistics and support
- compliance with international standards and local certification
- compliance with applicable ANSI C37 standard, UL 508 standard, CSA C22 standard

DE51860 DE51861 DE51862

Sepam Offers Flexibility to Meet Your Needs

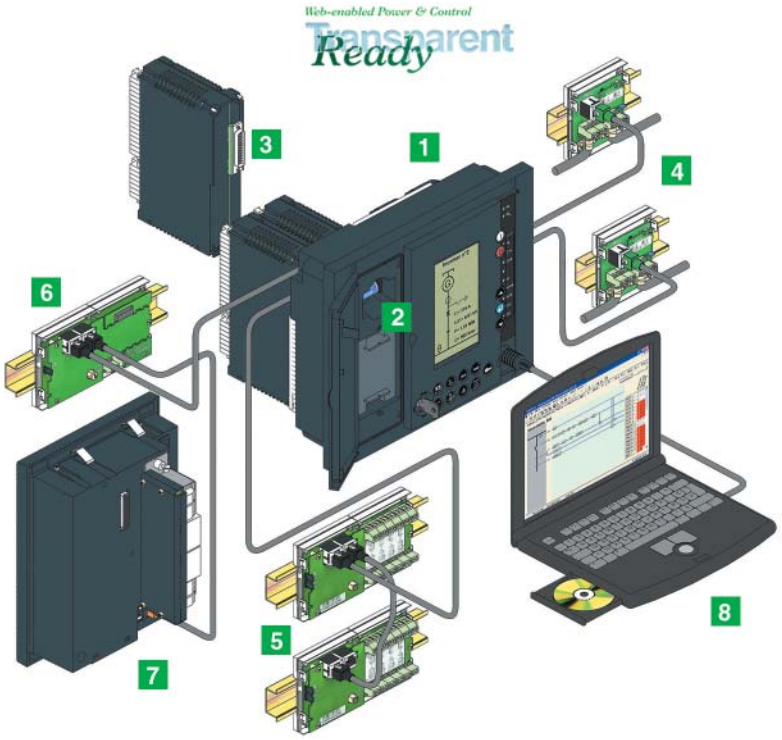
Enhancement through the addition of optional modules to keep pace with your ever-changing installation

To adapt to as many situations as possible and allow for future installation upgrades, optional modules may be added to Sepam at any time for new functions:

- plug & play modules, easy to install and connect
- complete setup using software

1. **Base unit**
2. **Parameter and protection settings saved on removable memory cartridge**
3. **42 logic inputs and 23 relay outputs with 3 optional modules**
4. **Connection to communication networks**
5. **Temperature sensors**
6. **Low-level analog output**
7. **Synchro-check module**
8. **Software tools**

PE50483

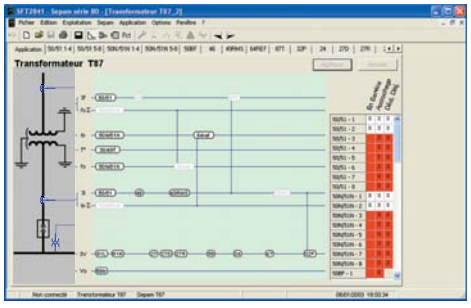


Sepam Series 80 and its optional modules.

A choice of user-machine interfaces (UMI) to meet your operating needs

- advanced UMI for all Sepam relays:
  - on front panel
  - or remote UMI installed in the most convenient location for the facility manager
- mimic-based UMI for Sepam series 80, offering local switchgear control

PE50041



SFT2841: a single software tool for all Sepam relays.

A software tool for all Sepam relays

The SFT2841 software is the setting and operating tool for Sepam Series 20, Series 40 and Series 80.

- the ergonomics are designed to guide you in setting up Sepam
- future compatibility is ensured with all Sepam versions.

Sepam Boosts Productivity

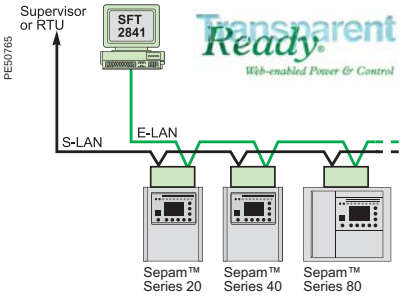
Easy operation

To ensure fast and effective servicing, thereby reducing the operating and maintenance costs of your electric installation, all operating and maintenance information is available:
- locally and remotely
- in your language

Local operation

All the data required for local equipment operation are clearly displayed on the LCD screen of the UMI (User-Machine Interface).
- UMI screens are shipped with English as the default, but can be translated to your language
- alarms and operating messages can be personalized

Customized advanced UMI.



Sepam connection to two communication networks.

Remote operation

All Sepam relays can be connected to two types of communication networks:
- **an S-LAN (supervisory local area network)** to remotely control and monitor Sepam relays connected to a supervisory system (SCADA or RTU)
- **an E-LAN (engineering local area network),** reserved for Sepam remote parameter setting and centralized installation diagnosis using the SFT2841 software.

Improved continuity of service

With Sepam, all data is available for optimum management and use of the electric installation.
- The clear and complete information supplied by Sepam following a fault trip enables the operator to restore power as quickly as possible.
- Preventive maintenance of switchgear is made easier by the diagnosis functions provided by Sepam.
- The predictive information supplied by the motor-protection functions optimizes process control.

Reduced maintenance costs

The Sepam range is designed to reduce maintenance time and cost for your protection system.
- Sepam modules and connectors may be removed.
- The optional modules are the same for the entire Sepam range, thus reducing the stock of replacement parts.
- Sepam series 80 has a removable memory cartridge to simplify maintenance operations.

Sepam series 80 memory cartridge.

Overview of Sepam Applications

The selection guide proposes the Sepam types suited to your protection needs, based on the characteristics of your application.

The most typical applications are presented with the corresponding Sepam and each application example is described by:

- *a single-line diagram indicating:*
  - *equipment to be protected*
  - *network configuration*
  - *position of measurement sensors*
- *standard and specific Sepam functions to be implemented to protect the application.*

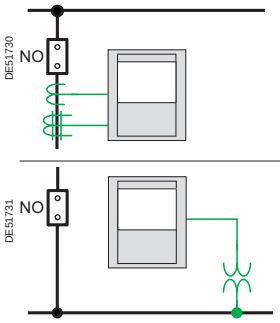
The list of functions is given for information purposes.

Grounding, whether direct or via an impedance, is represented by the same pictogram, i.e. the pictogram corresponding to a direct connection.

Sepam Series 20

For applications

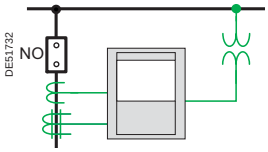
Characteristics
- 10 logic inputs
- 8 relay outputs
- 1 communication port
- 8 temperature-sensor inputs



Sepam Series 40

For demanding applications

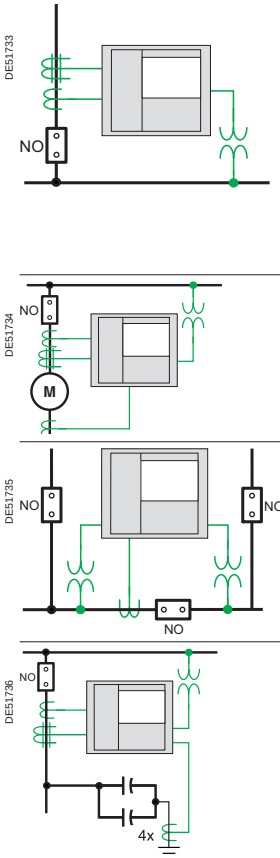
Characteristics
- 10 logic inputs
- 8 relay outputs
- logical equation editor
- 1 communication port
- 16 temperature-sensor inputs



Sepam Series 80

For custom applications

Characteristics
- 42 logic inputs
- 23 relay outputs
- logical equation editor
- 2 communication ports for multi-master or redundant architectures
- 16 temperature-sensor inputs
- removable memory cartridge with parameter and protection settings for fast return to service following replacement
- battery backup to save historical and disturbance-recording data
- mimic-based UMI for local device control
- optional Logipam programming software to program specific functions



Selection Guide for All Applications

Protection Functions		Applications						
Basic	**Specific**	**Substation**	**Bus**	**Transformer**	**Motor**	**Generator**	**Capacitor**	
current protection		**S20**		**T20**	**M20**			Page 41
	Breaker failure	**S23**		**T23**				
voltage and frequency protection			**B21**					
	disconnection by “rate of change of frequency”		**B22**					
current, voltage and frequency protection		**S40**		**T40**		**G40**		
	directional ground fault	**S41**			**M41**			
	directional ground fault and phase overcurrent	**S42**		**T42**				
current, voltage and frequency protection		**S80**	**B80**					Page 77
	directional ground fault	**S81**		**T81**	**M81**			
	directional ground fault and phase overcurrent	**S82**		**T82**		**G82**		
	disconnection by “rate of change of frequency”	**S84**						
current, voltage and frequency protection	transformer and transformer-machine unit differential			**T87**	**M88**	**G88**		
	machine differential				**M87**	**G87**		
current, voltage and frequency protection	voltage and frequency protection for two sets of bus		**B83**					
current, voltage and frequency protection	capacitor-bank unbalance						**C86**	
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Substation Applications
Feeder Protection

Protection Functions	ANSI code	S20	S23	B22	S40	S41	S42	S80	S81	S82	S84
Phase overcurrent (1)	50/51	4	4		4	4	4	8	8	8	8
Ground fault / Sensitive ground fault (1)	50N/51N 50G/51G	4	4		4	4	4	8	8	8	8
Breaker failure	50BF		1		1	1	1	1	1	1	1
Negative sequence / unbalance	46	1	1		2	2	2	2	2	2	2
Thermal overload for cables	49RMS								2	2	2
Directional phase overcurrent (1)	67						2			2	2
Directional ground fault (1)	67N/67NC					2	2		2	2	2
Directional active overpower	32P					1	1		2	2	2
Directional active underpower	37P										2
Positive sequence undervoltage	27D			2				2	2	2	2
Remanent undervoltage	27R			1				2	2	2	2
Undervoltage ($_{LL}$ or $_{Ln}$)	27			2/1 (4)	2	2	2	4	4	4	4
Overvoltage ($_{LL}$ or $_{Ln}$)	59			2	2	2	2	4	4	4	4
Neutral voltage displacement	59N			2	2	2	2	2	2	2	2
Negative sequence overvoltage	47				1	1	1	2	2	2	2
Overfrequency	81H			1	2	2	2	2	2	2	2
Underfrequency	81L			2	4	4	4	4	4	4	4
Rate of change of frequency	81R			1							2
Recloser (4 shots) (2)	79	□	□		□	□	□	□	□	□	□
Synchro-check (3)	25							□	□	□	□

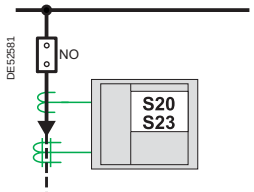
■ *standard* □ *options.*
(1) *Protection functions with 2 groups of settings.*
(2) *According to parameter setting and optional input/output modules.*
(3) *With optional MCS025 synchro-check module.*
(4) *2 undervoltage ($_{LL}$) and 1 undervoltage ($_{Ln}$).*
(5) *The digits in the matrix to the right of the ANSI code indicate the number of units available for each protection function.*

Feeder Protection

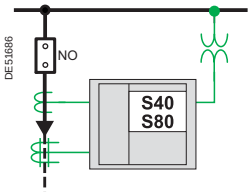
■ feeder short-circuit and overload protection.

Protection of low-capacitance feeders in impedance grounded or solidly grounded neutral systems: Sepam S20, S23, S40 or S80

■ no voltage and frequency monitoring.

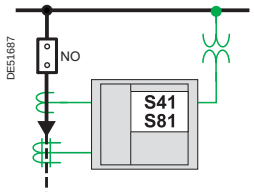


■ voltage and frequency monitoring.



Protection of high-capacitance feeders in impedance grounded or compensated or isolated neutral systems: Sepam S41 or S81

■ specific feeder protection: 67N/67NC.

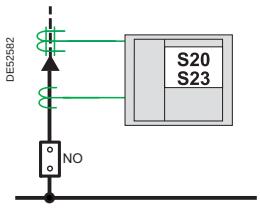


Main Protection

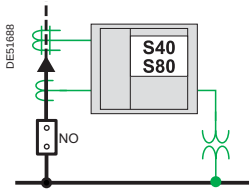
■ bus short-circuit protection.

Main protection: Sepam S20, S23, S40 or S80

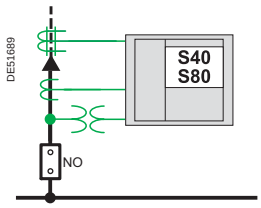
■ no voltage and frequency monitoring.



■ bus voltage and frequency monitoring.

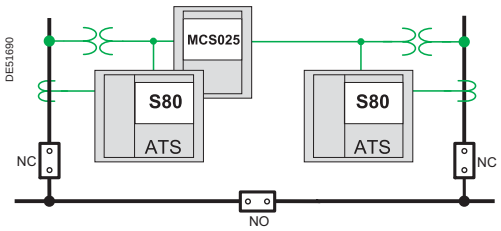


■ line voltage and frequency monitoring.



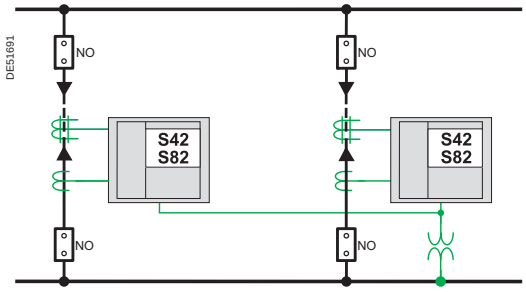
Protection of 2 mains: Sepam S80

■ with automatic source transfer (ATS) and synchro-check (ANSI 25).



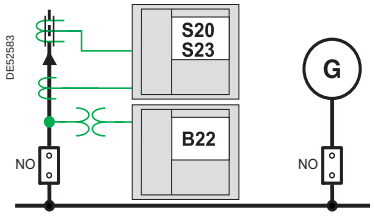
Parallel main protection: Sepam S42 or S82

■ specific line or source protection: 67, 67N/67NC.

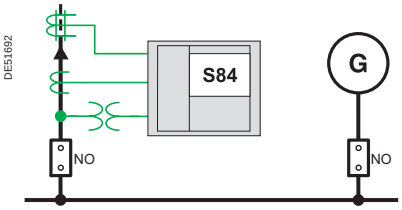


Parallel-main protection with disconnection function: Sepam S20 + B22 or Sepam S84

■ disconnection-specific functions: 27,59, 59N, 81L, 81R.

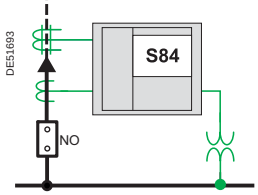


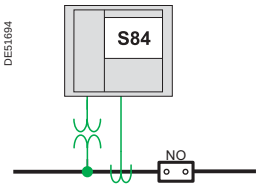
■ disconnection-specific functions: 27,59, 59N, 81L, 81R, 32P, 37P.



Protection of any main or tie breaker circuit breaker with load shedding based on frequency variations: Sepam S84

■ load-shedding-specific functions: 81L, 81R.

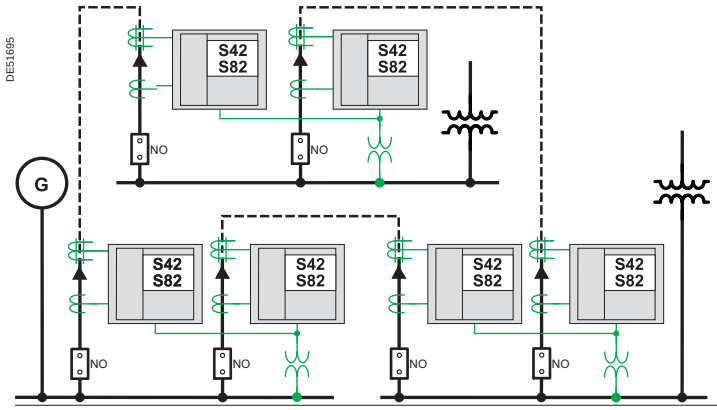




Ring-main protection: Sepam S42 or S82

■ line or source protection: 67, 67N/67NC

■ directional Zone Sequence Interlocking (ZSI).



Bus Applications

Protection Functions	ANSI code	B21	B22	B80	B83
Phase overcurrent (1)	50/51			8	8
Ground fault / Sensitive ground fault (1)	50N/51N 50G/51G			8	8
Breaker failure	50BF			1	1
Negative sequence / unbalance	46			2	2
Positive sequence undervoltage	27D	2	2	2	2
Remanent undervoltage	27R	1	1	2	2
Undervoltage ($_{LL}$ or $_{Ln}$)	27	2/1 (3)	2/1 (3)	4	4
Overvoltage ($_{LL}$ or $_{Ln}$)	59	2	2	4	4
Neutral voltage displacement	59N	2	2	2	2
Negative sequence overvoltage	47			2	2
Overfrequency	81H	1	1	2	2
Underfrequency	81L	2	2	4	4
Rate of change of frequency	81R		1		
Synchro-check (2)	25			□	□

■ *standard* □ *options.*
(1) *Protection functions with 2 groups of settings.*
(2) *With optional MCS025 synchro-check module.*
(3) *2 undervoltage ($_{LL}$) and 1 undervoltage ($_{Ln}$).*
(4) *The digits in the matrix to the right of the ANSI code indicate the number of units available for each protection function.*

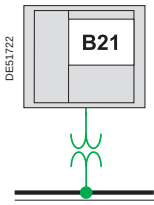
Bus Applications

Voltage Monitoring

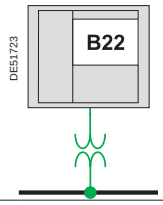
■ voltage and frequency monitoring.

Monitoring of the 3 phase voltages and the residual voltage on buses: Sepam B21 or B22

■ load-shedding-specific function: 81L.



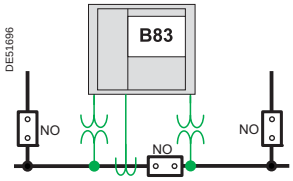
■ load-shedding-specific functions: 81L, 81R.



Tie Breaker Circuit-Breaker Protection

■ bus short-circuit protection
■ voltage and frequency monitoring.

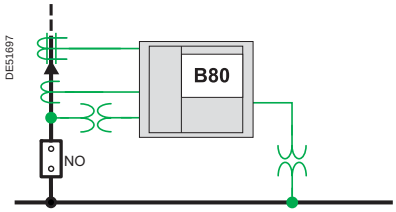
Monitoring of the 3 phase voltages and the residual voltage on 2 buses: Sepam B83



Main Protection with Additional Bus Voltage Monitoring

■ bus short-circuit protection
■ line voltage and frequency monitoring.

Additional bus voltage monitoring: Sepam B80



Transformer Applications

Standard transformer application diagrams do not take voltage levels into account:

- *the transformer primary winding is always at the top*
- *the transformer secondary winding is always at the bottom.*
- *the transformer primary and secondary windings need to be protected.*
- *the Sepam relay can be installed on either the primary or secondary winding of the transformer.*
- *the other winding can be protected by a main or feeder type substation application.*

Protection Functions	ANSI code	T20	T23	T40	T42	T81	T82	T87
Phase overcurrent (1)	50/51	4	4	4	4	8	8	8
Ground fault / Sensitive ground fault (1)	50N/51N 50G/51G	4	4	4	4	8	8	8
Breaker failure	50BF		1	1	1	1	1	1
Negative sequence / unbalance	46	1	1	2	2	2	2	2
Thermal overload for machines (1)	49RMS	2	2	2	2	2	2	2
Restricted ground fault differential	64REF					2	2	2
Two-winding transformer differential	87T							1
Directional phase overcurrent (1)	67				2		2	2
Directional ground fault (1)	67N/67NC				2	2	2	2
Directional active overpower	32P					2	2	2
Overexcitation (V / Hz)	24							2
Positive sequence undervoltage	27D					2	2	2
Remanent undervoltage	27R					2	2	2
Undervoltage (U_{LL} or U_{Ln})	27			2	2	4	4	4
Overvoltage (U_{LL} or U_{Ln})	59			2	2	4	4	4
Neutral voltage displacement	59N			2	2	2	2	2
Negative sequence overvoltage	47			1	1	2	2	2
Overfrequency	81H			2	2	2	2	2
Underfrequency	81L			4	4	4	4	4
Thermostat / Buchholz (2)	26/63	□	□	□	□	□	□	□
Temperature monitoring (16 RTDs) (3)	38/49T	□ 8 RTDs	□ 8 RTDs	□ 16 RTDs	□ 16 RTDs	□ 16 RTDs	□ 16 RTDs	□ 16 RTDs
Synchro-check (4)	25					□	□	□

■ *standard* □ *options.*

(1) *Protection functions with 2 groups of settings.*

(2) *According to parameter setting and optional input/output modules.*

(3) *With optional MET1482 temperature input modules.*

(4) *With optional MCS025 synchro-check module.*

(5) *The digits in the matrix to the right of the ANSI code indicate the number of units available for each protection function.*

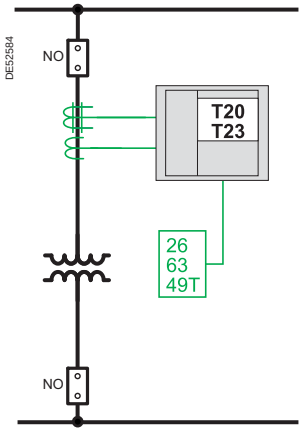
Transformer Applications
Transformer Feeder Protection

Transformer Feeder Protection

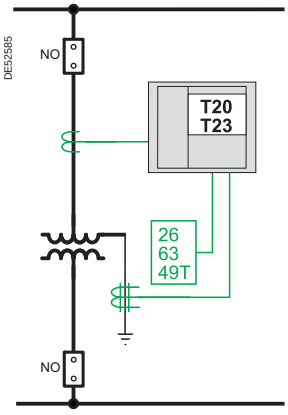
- transformer short-circuit and overload protection
- internal transformer protection: Thermostat / Buchholz (ANSI 26/63)
- RTD temperature monitoring (ANSI 49T).

Transformer feeder protection without voltage monitoring: Sepam T20, T23

Ground fault protection:
- primary: 50G/51G.

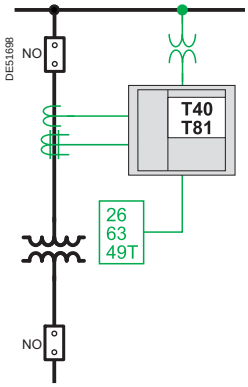


Ground fault protection:
- neutral point: 50G/51G.



Transformer feeder protection with voltage monitoring: Sepam T40 or T81

Ground fault protection:
- primary: 50G/51G.

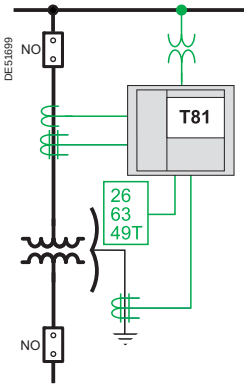


Note: *for long feeders, the 50G/51G function may be replaced by the 67N/67NC.*

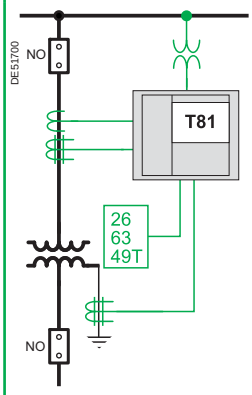
Transformer Applications
Transformer Feeder Protection

Transformer feeder protection with voltage monitoring and additional current measurement: Sepam T81

Ground fault protection:
- primary: 50G/51G
- tank ground leakage: 50G/51G.



Ground fault protection:
- primary: 50G/51G
- secondary: 50G/51G.

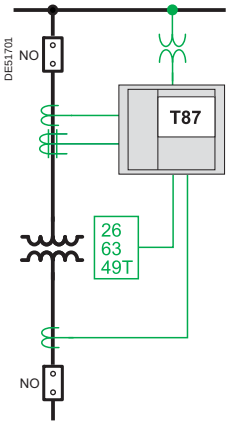


Note: *for long feeders, the 50G/51G function may be replaced by the 67N/67NC.*

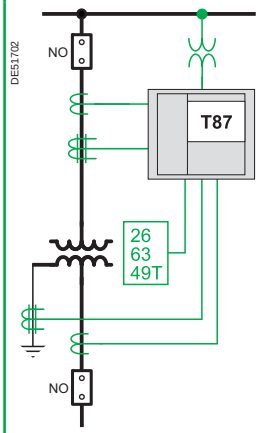
Transformer feeder differential protection: Sepam T87

Transformer differential protection: 87T

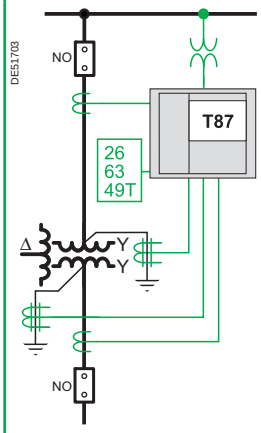
Ground fault protection:
- primary: 50G/51G.



Ground fault protection:
- primary: 50G/51G
- secondary:
  - 64REF
  - 50G/51G.



Ground fault protection:
- primary:
  - 64REF
  - 50G/51G
- secondary:
  - 64REF
  - 50G/51G.



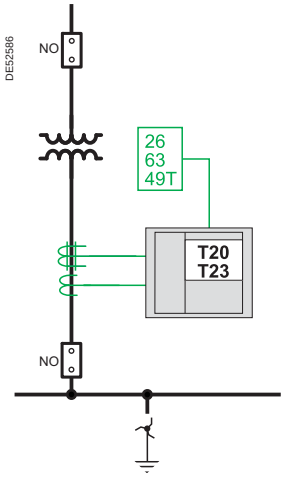
Transformer Applications
Transformer Main Protection

Transformer Main Protection

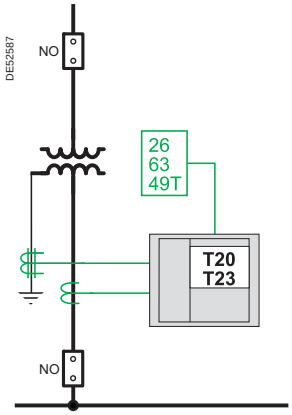
- transformer short-circuit and overload protection
- internal transformer protection: Thermostat / Buchholz (ANSI 26/63)
- RTD temperature monitoring (ANSI 49T).

Transformer main protection without voltage monitoring: Sepam T20, T23

Ground fault protection:
- secondary: 50G/51G.

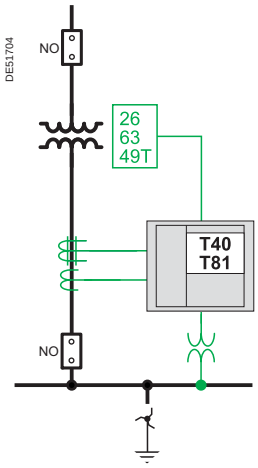


Ground fault protection:
- neutral point: 50G/51G.

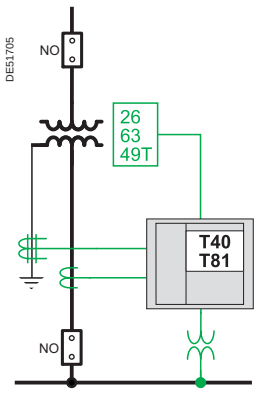


Transformer main protection with voltage monitoring: Sepam T40 or T81

Ground fault protection:
- secondary: 50G/51G.



Ground fault protection:
- secondary:
  - 64REF
  - 50G/51G.

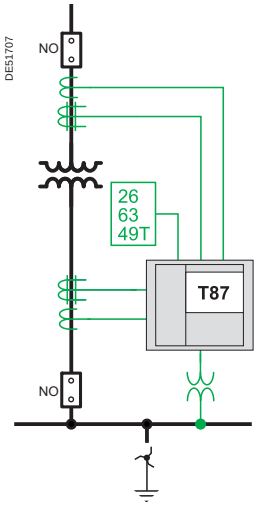


Transformer Applications
Transformer Main Protection

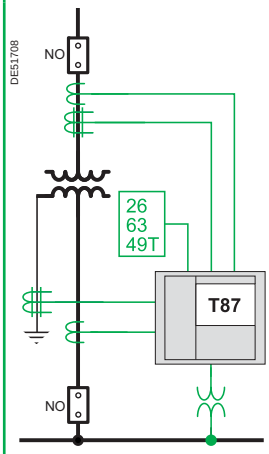
Transformer main differential protection: Sepam T87

Transformer differential protection: 87T

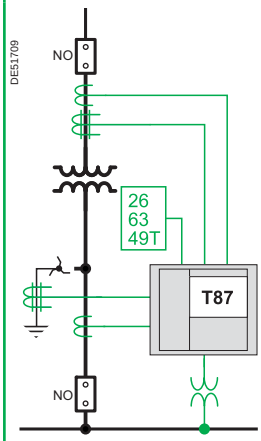
Ground fault protection:
- primary: 50G/51G
- secondary: 50G/51G.



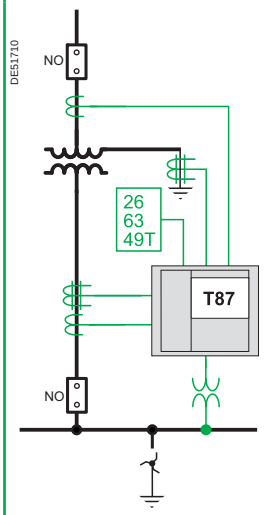
Ground fault protection:
- primary: 50G/51G
- secondary:
  - 64REF
  - 50G/51G.



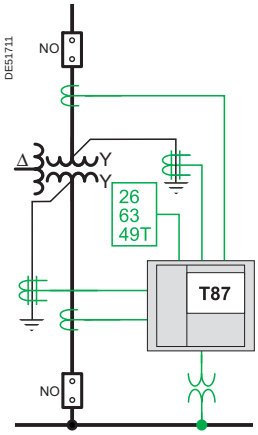
Ground fault protection:
- primary: 50G/51G
- secondary:
  - 64REF
  - 50G/51G.



Ground fault protection:
- primary:
  - 64REF
  - 50G/51G
- secondary: 50G/51G.

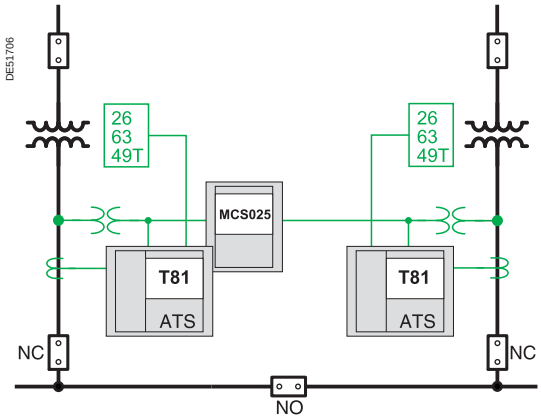


Ground fault protection:
- primary:
  - 64REF
  - 50G/51G
- secondary:
  - 64REF
  - 50G/51G.



Protection of 2 non-coupled transformer mains: Sepam T81

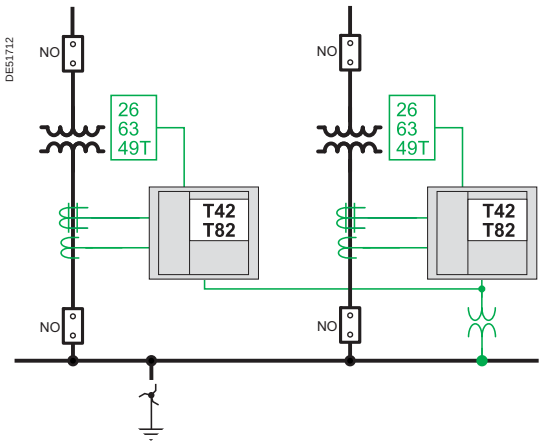
- automatic source transfer (ATS)
- synchro-check (ANSI 25).



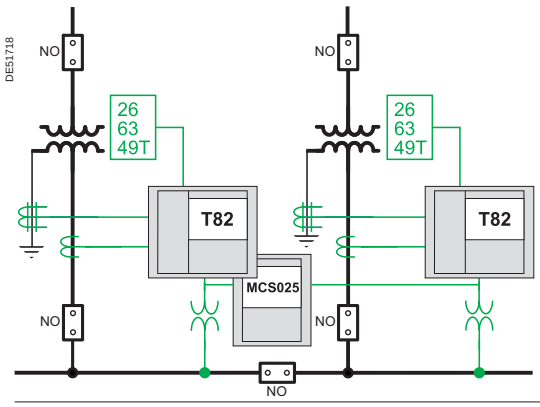
Transformer Applications
Transformer Main Protection

Parallel transformer main protection: Sepam T42 or T82

- transformer directional phase overcurrent protection: 67
- transformer secondary ground fault protection: 50G/51G, 59N.

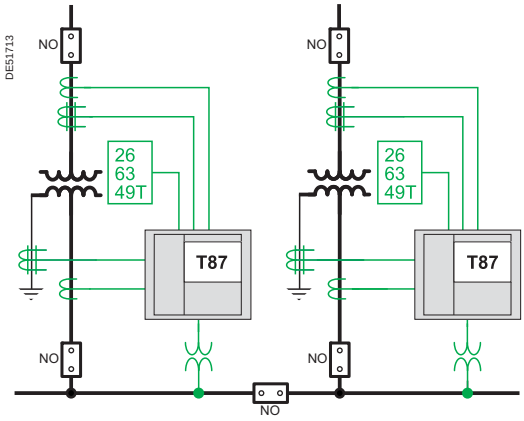


- transformer directional phase overcurrent protection: 67
- transformer secondary ground fault protection: 67N/67NC, 64REF
- with synchro-check (ANSI 25).



Parallel main differential protection: Sepam T87

- transformer differential protection: 87T
- directional transformer protection: 67
- transformer secondary ground fault protection: 50G/51G, 67N/67NC 64REF.



Motor Applications

Protection Functions	ANSI code	M20	M41	M81	M87	M88
Phase overcurrent (1)	50/51	4	4	8	8	8
Ground fault / Sensitive ground fault (1)	50N/51N 50G/51G	4	4	8	8	8
Breaker failure	50BF		1	1	1	1
Negative sequence / unbalance	46	1	2	2	2	2
Thermal overload for machines (1)	49RMS	2	2	2	2	2
Two-winding transformer differential	87T					1
Machine differential	87M				1	
Directional ground fault (1)	67N/67NC		2	2	2	2
Directional active overpower	32P		1	2	2	2
Directional reactive overpower	32Q/40		1	1	1	1
Field loss (underimpedance)	40			1	1	1
Phase undercurrent	37	1	1	1	1	1
Excessive starting time, locked rotor	48/51LR/14	1	1	1	1	1
Starts per hour	66	1	1	1	1	1
Loss of synchronization	78PS			1	1	1
Overspeed (2 set points) (2)	12			□	□	□
Underspeed (2 set points) (2)	14			□	□	□
Positive sequence undervoltage	27D		2	2	2	2
Remanent undervoltage	27R		1	2	2	2
Undervoltage ($_{LL}$ or $_{Ln}$)	27		2	4	4	4
Overvoltage ($_{LL}$ or $_{Ln}$)	59		2	4	4	4
Neutral voltage displacement	59N		2	2	2	2
Negative sequence overvoltage	47		1	2	2	2
Overfrequency	81H		2	2	2	2
Underfrequency	81L		4	4	4	4
Thermostat / Buchholz	26/63			□		□
Temperature monitoring (16 RTDs) (3)	38/49T	□ 8 RTDs	□ 16 RTDs	□ 16 RTDs	□ 16 RTDs	□ 16 RTDs

■ *standard* □ *options.*
(1) *Protection functions with 2 groups of settings.*
(2) *According to parameter setting and optional input/output modules.*
(3) *With optional MET1482 temperature input modules.*
(4) *The digits in the matrix to the right of the ANSI code indicate the number of units available for each protection function.*

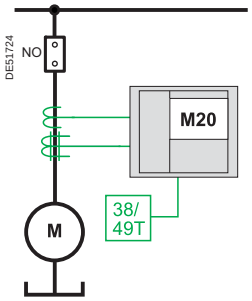
Motor Applications

Motor Protection

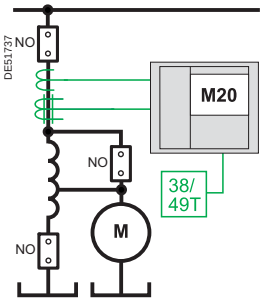
- internal motor fault protection
- power supply fault protection
- driven load fault protection
- RTD temperature monitoring (ANSI 38/49T).

Motor protection without voltage monitoring: Sepam M20

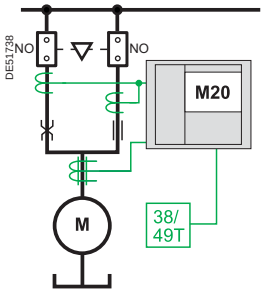
■ direct starting.



■ auto-transformer starting.

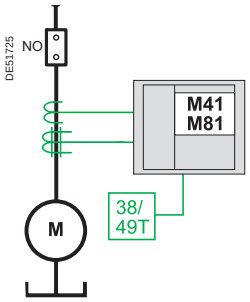


■ two-way.

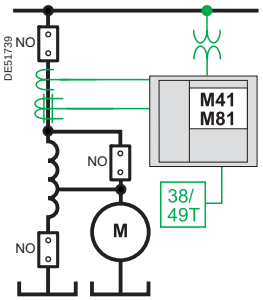


Motor protection with voltage monitoring: Sepam M41 or M81

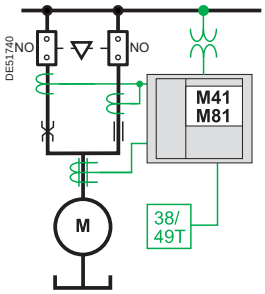
■ direct starting.



■ auto-transformer starting.



■ two-way.

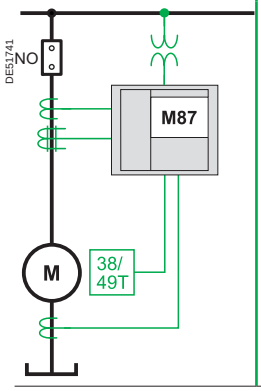


Motor differential protection: Sepam M87

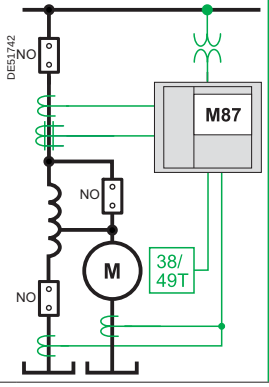
Motor differential protection: 87M.

Phase protection by self-balancing-differential scheme: 50/51.

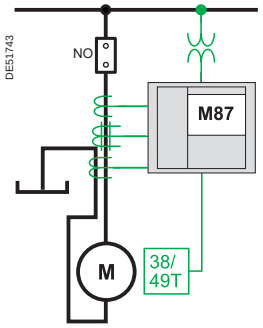
■ direct starting.



■ auto-transformer starting.



■ direct starting.



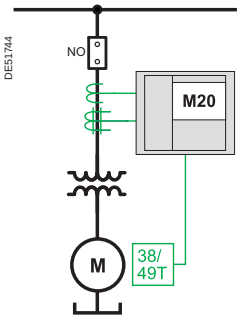
Motor-Transformer Unit Protection

- motor and transformer protection against internal faults
- power supply fault protection
- driven load fault protection
- internal transformer protection: Thermostat / Buchholz (ANSI 26/63)
- RTD temperature monitoring (ANSI 38/49T).

Motor-transformer unit protection without voltage monitoring: Sepam M20

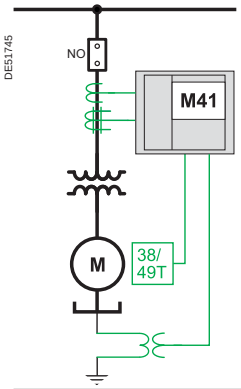
- transformer primary ground fault protection: 50G/51G.

Note: *monitoring of motor insulation must be ensured by another device.*



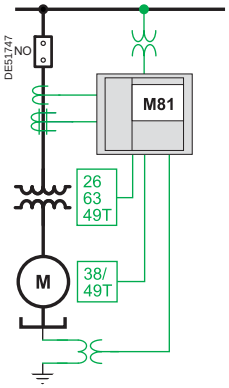
Motor-transformer unit protection with voltage monitoring: Sepam M41

- motor ground fault protection: 59N
- transformer primary ground fault protection: 50G/51G.

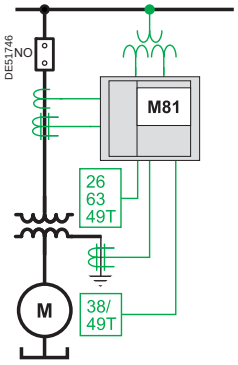


Motor-transformer unit protection with voltage and transformer monitoring: Sepam M81

- motor ground fault protection: 59N
- transformer primary ground fault protection: 50G/51G
- transformer monitoring: Buchholz, thermostat, temperature measurement.



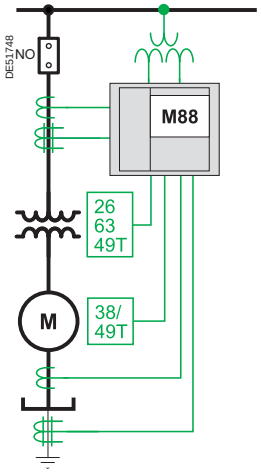
- motor ground fault protection: 50G/51G
- transformer primary ground fault protection: 50G/51G
- transformer monitoring: Buchholz, thermostat, temperature measurement.



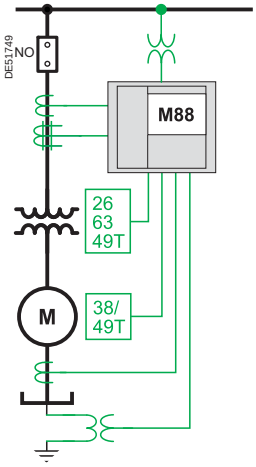
Motor-transformer unit differential protection: Sepam M88

Motor-transformer unit differential protection: 87T.

- motor ground fault protection: 50G/51G
- transformer primary ground fault protection: 50G/51G.



- motor ground fault protection: 59N
- transformer primary ground fault protection: 50G/51G.



Generator Applications

Protection Functions	ANSI code	G40	G82	G87	G88
Phase overcurrent (1)	50/51	4	8	8	8
Ground fault / Sensitive ground fault (1)	50N/51N 50G/51G	4	8	8	8
Breaker failure	50BF	1	1	1	1
Negative sequence / unbalance	46	2	2	2	2
Thermal overload for machines (1)	49RMS	2	2	2	2
Restricted ground fault differential	64REF		2		2
Two-winding transformer differential	87T				1
Machine differential	87M			1	
Directional phase overcurrent (1)	67		2	2	2
Directional ground fault (1)	67N/67NC		2	2	2
Directional active overpower	32P	1	2	2	2
Directional reactive overpower	32Q/40	1	1	1	1
Directional active underpower	37P		2		
Field loss (underimpedance)	40		1	1	1
Loss of synchronization	78PS		1	1	1
Overspeed (2 set points) (2)	12		□	□	□
Underspeed (2 set points) (2)	14		□	□	□
Voltage-restrained phase overcurrent	50V/51V	1	2	2	2
Underimpedance	21B		1	1	1
Inadvertent energization	50/27		1	1	1
Third harmonic undervoltage / 100% stator ground fault	27TN/64G2 64G		2	2	2
Overexcitation (V / Hz)	24		2	2	2
Positive sequence undervoltage	27D		2	2	2
Remanent undervoltage	27R		2	2	2
Undervoltage ($_{LL}$ or $_{Ln}$)	27	2	4	4	4
Overvoltage ($_{LL}$ or $_{Ln}$)	59	2	4	4	4
Neutral voltage displacement	59N	2	2	2	2
Negative sequence overvoltage	47	1	2	2	2
Overfrequency	81H	2	2	2	2
Underfrequency	81L	4	4	4	4
Thermostat / Buchholz	26/63		□		□
Temperature monitoring (16 RTDs) (3)	38/49T	□ 16 RTDs	□ 16 RTDs	□ 16 RTDs	□ 16 RTDs
Synchro-check (4)	25		v	v	v

■ *standard* □ *options.*
(1) *Protection functions with 2 groups of settings.*
(2) *According to parameter setting and optional input/output modules.*
(3) *With optional MET1482 temperature input modules.*
(4) *With optional MCS025 synchro-check module.*
(5) *The digits in the matrix to the right of the ANSI code indicate the number of units available for each protection function.*

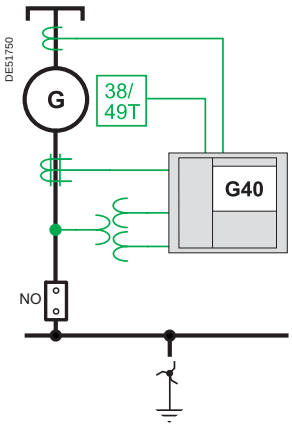
Generator Applications

Generator Protection

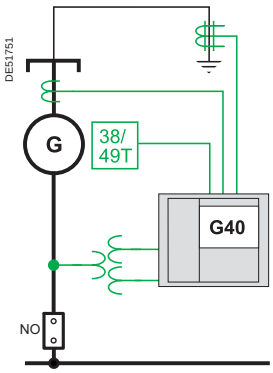
- internal generator fault protection
- network fault protection
- driving machine fault protection
- RTD temperature monitoring (ANSI 38/49T)
- voltage and frequency monitoring.

Protection of a separate generator: Sepam G40

Ground fault protection:
- 50G/51G
- 59N.



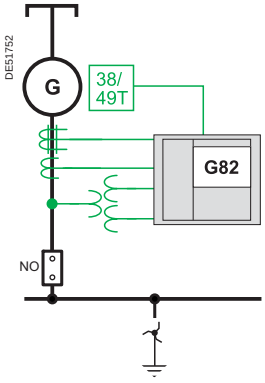
Ground fault protection:
- 50G/51G.



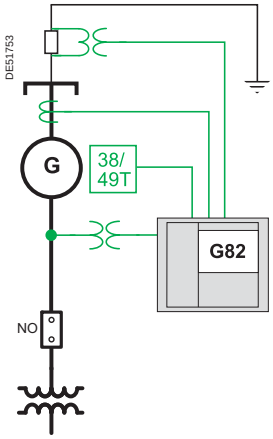
Protection of a generator coupled to other generators or to a network: Sepam G82

Short-circuit detection on generator side: 67.
Control fault protection.

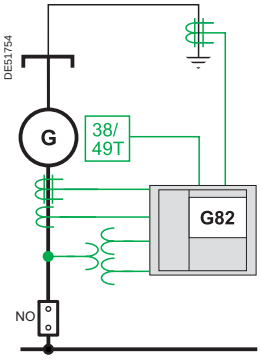
Ground fault protection:
- 50G/51G
- 59N.



Ground fault protection:
- 100 % stator ground fault 64G.



Ground fault protection:
- 64REF and 50G/51G
- 50N/51N.



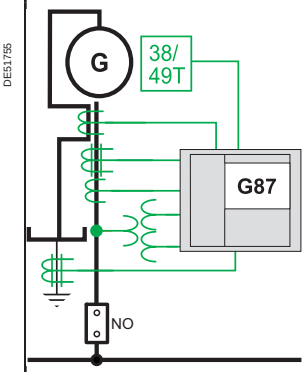
Generator Applications

Generator Differential protection: Sepam G87

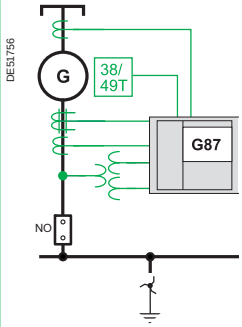
Phase protection by self-balancing differential scheme: 50/51.

Generator differential protection: 87M.

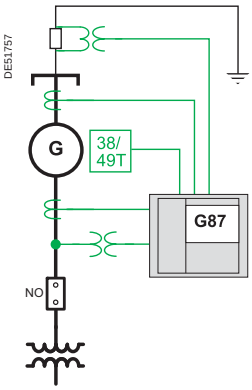
Ground fault protection: 50G/51G.



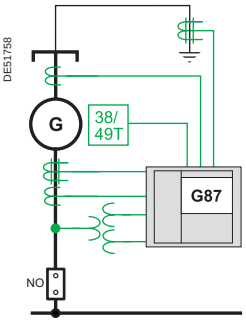
Ground fault protection:
- 50G/51G
- 59N.



Ground fault protection:
- 100 % stator ground fault 64G.



Ground fault protection:
- 50N/51N.



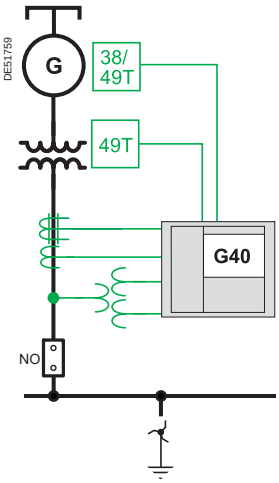
Generator-Transformer Unit Protection

- generator and transformer protection against internal faults
- network fault protection
- driving machine fault protection
- RTD temperature monitoring (ANSI 38/49T)
- voltage and frequency monitoring.

Separate generator-transformer unit protection. Sepam G40

Ground fault protection:
- 50G/51G.

Note: *monitoring of generator insulation must be ensured by another device.*

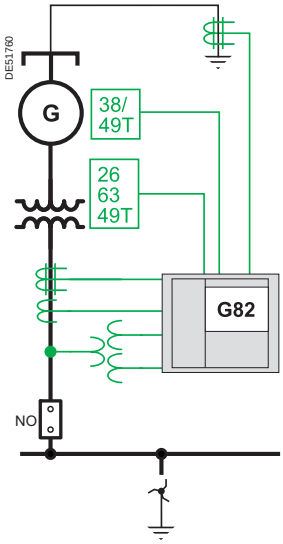


Generator Applications

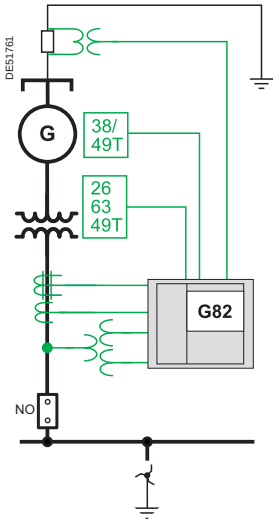
Protection of a generator-transformer unit coupled to other generators or to a network: Sepam G82

Short-circuit detection on generator side: 67.
Control fault protection.
Internal transformer protection: Thermostat / Buchholz (ANSI 26/63).

- generator ground fault protection: 50G/51G
- transformer secondary ground fault protection:
  - 50G/51G
  - 59N.



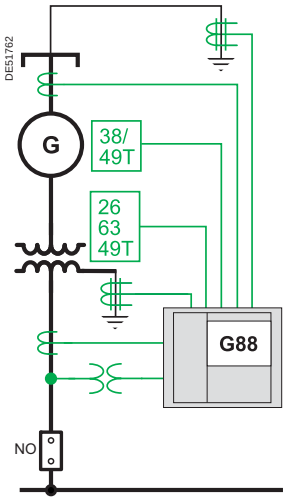
- generator ground fault protection: 100 % stator ground fault 64G
- transformer secondary ground fault protection:
  - 50G/51G
  - 59N.



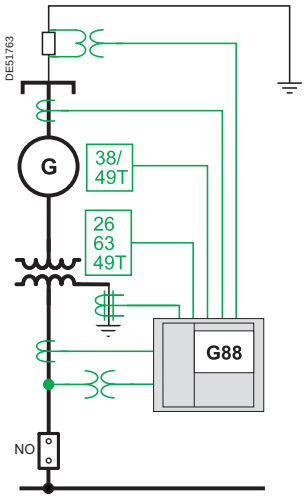
Generator-transformer unit differential protection: Sepam G88

Generator-transformer unit differential protection: 87T.

- generator ground fault protection: 50G/51G
- transformer secondary ground fault protection:
  - 50G/51G.



- generator ground fault protection: 100% stator ground fault 64G
- transformer secondary ground fault protection:
  - 50G/51G
  - 64REF.



Capacitor Applications

Protection Functions	ANSI code	S20	S23	S40	C86
Phase overcurrent (1)	50/51	4	4	4	8
Ground fault / Sensitive ground fault (1)	50N/51N 50G/51G	4	4	4	8
Breaker failure	50BF		1	1	1
Negative sequence / unbalance	46	1	1	2	2
Thermal overload for capacitors (1)	49RMS				2
Capacitor-bank unbalance	51C				8
Positive sequence undervoltage	27D				2
Remanent undervoltage	27R				2
Undervoltage ($_{LL}$ or $_{Ln}$)	27			2	4
Overvoltage ($_{LL}$ or $_{Ln}$)	59			2	4
Neutral voltage displacement	59N			2	2
Negative sequence overvoltage	47			1	2
Overfrequency	81H			2	2
Underfrequency	81L			4	4
Temperature monitoring (16 RTDs) (2)	38/49T				□ 16 RTDs

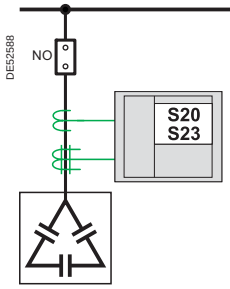
■ *standard* □ *options.*
(1) *Protection functions with 2 groups of settings.*
(2) *With optional MET1482 temperature input modules.*
(3) *The digits in the matrix to the right of the ANSI code indicate the number of units available for each protection function.*

Capacitor Applications

Capacitor Bank Protection

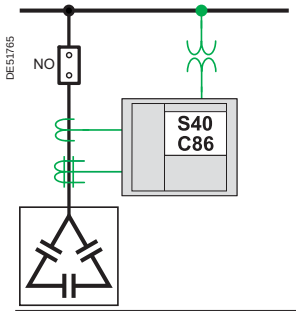
Protection of a capacitor bank (delta connection) without voltage monitoring: Sepam S20, S23

- capacitor bank short-circuit protection.



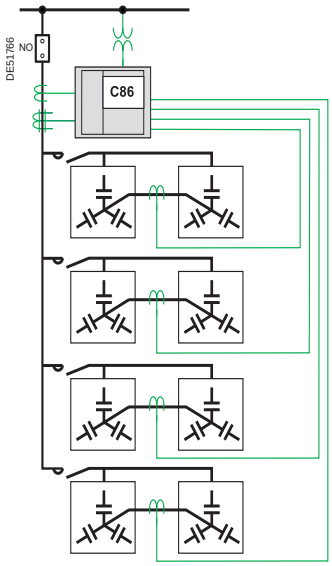
Protection of a capacitor bank (delta connection) with voltage monitoring: Sepam S40 or C86

- capacitor bank short-circuit protection
- voltage and frequency monitoring
- overload protection: ANSI 49RMS (Sepam C86 only).



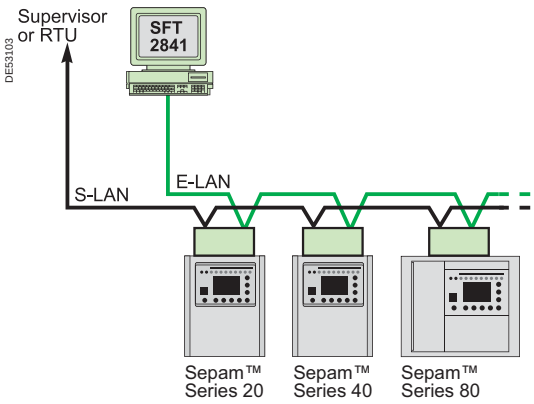
Protection of a double-wye connected capacitor bank with 1 to 4 steps: Sepam C86

- capacitor bank short-circuit protection
- voltage and frequency monitoring
- specific overload protection, self-adapted to the number of connected steps
- unbalance protection: 51C.



Communication Networks and Protocols

All Sepam relays communicate and can be integrated into communication architecture. All Sepam information can be accessed remotely.



Sepam connection to two communication networks (S-LAN and E-LAN).

Two Types of Communication Network

Sepam relays can be connected to two types of networks, thus providing access to different types of information:
- a supervisory local area network or S-LAN
- an engineering local area network or E-LAN.

Examples of communication architectures are presented on pages 30 and 31.

Supervisory local area network (S-LAN)

An S-LAN is used for supervision functions concerning the installation and the electric network. It can be used to connect a set of communicating devices using the same communication protocol to a centralized supervision system. Sepam can be connected to an S-LAN using one of the following communication protocols:
- Modbus RTU
- Modbus TCP/IP
- DNP3
- IEC 60870-5-103
- IEC 61850

Engineering local area network (E-LAN)

An E-LAN is intended for Sepam parameter-setting and operating functions. It can be used to connect a set of Sepam units to a PC running the SFT2841 software.
In this configuration, the operator has remote and centralized access to all Sepam information, with no need to develop any special communication software. The operator can easily:
- set up the Sepam general parameters and functions
- collect all Sepam operating and diagnostics information
- manage the protection system for the electric network
- monitor the status of the electric network
- run diagnostics on any incidents affecting the electric network.

Communication Protocols

Modbus RTU

Modbus RTU is a data-transmission protocol, a de facto standard since 1979 widely used in industry and accepted by many communicating devices. For more information on the Modbus RTU protocol, visit www.modbus.org.

Modbus TCP/IP

The Modbus TCP/IP Ethernet communication protocol offers the same functions as Modbus RTU as well as compatibility with multi-master architectures

DNP3

DNP3 is a data-transmission protocol specially suited to the needs of utilities for remote control/monitoring of substations in the electric network. For more information on the DNP3 protocol, visit www.dnp.org.

IEC 60870-5-103

IEC 60870-5-103 is an accompanying standard for the standards in the IEC 60870-5 series. It defines communication between protection devices and the various devices in a control system (supervisor or RTU) in a substation. For more information on the IEC 60870-5-103 protocol, visit www.iec.ch.

IEC 61850

The standards in the IEC 61850 series define a protocol for communication in electrical substations. This Ethernet-based protocol offers advanced characteristics and interoperability between multi-vendor devices. The Sepam relay handles the station bus, in compliance with standards IEC 61850-6, 7-1, 7-2, 7-3, 7-4 and 8-1. For more information on the IEC 61850 protocol, visit www.iec.ch.

Communication Networks and Protocols

Other protocols

A gateway / protocol converter must be used to connect Sepam to a communication network based on other protocols.

IEC 60870-5-101

The CN1000 gateway developed by EuroSystem enables Sepam connection to IEC 60870-5-101 networks. This gateway is quick and simple to implement using the supplied configuration software integrating all Sepam parameters. For more information on the CN1000 gateway, visit www.euro-system.fr.

Implementation

PE50530

A complete range of Sepam communication interfaces

PE80033-36

PE50161

Access to Sepam information via a web browser.

Sepam Communication Interfaces

A complete range of accessories

Sepam connects to a communication network via a communication interface. Selection of the interface depends on the communication architecture:

- number of networks to be connected:
  - 1 network, S-LAN or E-LAN
  - 2 networks, S-LAN and E-LAN
- communication protocol selected for the S-LAN: Modbus RTU, DNP3, IEC 60870-5-103 or IEC 61850
- network physical interface:
  - 2-wire or 4-wire RS485
  - Ethernet
  - fiber optic, with wye or ring architecture.

Sepam communication interfaces are presented in detail on page 158.

Direct Sepam connection to the Ethernet network

Sepam series 40 and Sepam series 80 units can be directly connected to the Ethernet network via the ACE 850 communication interface. In this way they make full use of Ethernet network performance and all IEC 61850 functions.

- Compatible communication protocols:
  - Modbus TCP/IP
  - IEC 61850
- Network physical interface:
  - 10 baseT /100 base TX (wye architecture)
  - 100 base FX (wye architecture).

Easy implementation

The communication interfaces are remote modules that are easy to install and connect. The SFT2841 software is used for complete setup of the communication interfaces:

- protocol selection and setup of the functions specific to each protocol
- setup of the physical interface.

Advanced configuration of IEC 61850 protocol

The SFT850 software is used for advanced configuration of the IEC 61850 protocol for both the ECI850 server and the ACE850 communication interface:

- complete Sepam-configuration database (.icd)
- processing of system-configuration files (.scd)
- creation and processing of ECI850 and ACE850 configuration files (.cid).

Sepam IEC 61850 server

The entire Sepam range can be connected to an IEC 61850 system via the Sepam ECI850 server, representing the most economical solution. The server also ensures compatibility with the E-LAN network.

Ethernet Gateways in a Modbus Environment

Sepam can be connected to an Ethernet TCP/IP network in a totally transparent manner via the EGX100 gateway or the EGX400 server.

EGX100 gateway

The EGX100 offers access to enhanced communication and multi-master architectures. It provides IP (Internet Protocol) connection for communication on all types of networks, notably intranets and internet.

EGX400 server

In addition to Ethernet TCP/IP connection, the EGX400 offers a web server and HTML pages designed specially to present the essential Sepam information. This information may be accessed in clear text and at no risk on any PC connected to the intranet/ internet and equipped with a web browser.

Examples of Architectures

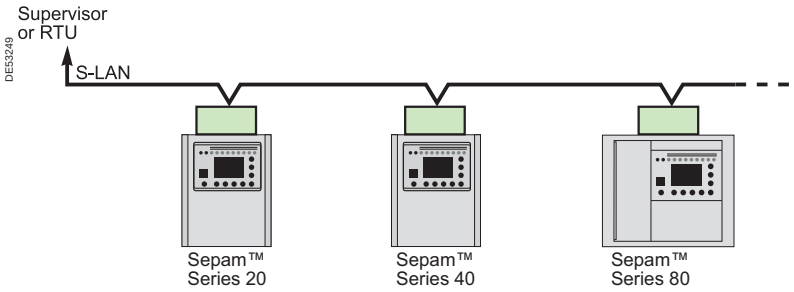
Seven typical communication architectures are presented in the examples below. Each architecture is presented with:
- a simplified diagram
- the characteristics of the implemented networks.

The physical architecture of the communication networks and the connection to networks depends on the type of network (RS485 or fiber optic) and the communication interfaces used. Sepam communication interfaces are presented in detail on page 158.

Example 1. Single S-LAN network

S-LAN characteristics

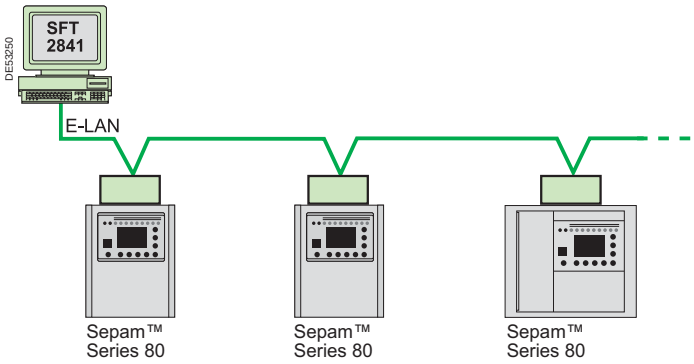
Protocol	Modbus RTU DNP3 or IEC 60870-5-103
Physical medium	Twisted-pair (2-wire or 4-wire RS485) or fiber optic



Example 2. Single E-LAN network

E-LAN characteristics

Protocol	Modbus RTU
Physical medium	Twisted-pair (2-wire or 4-wire RS485) or fiber optic



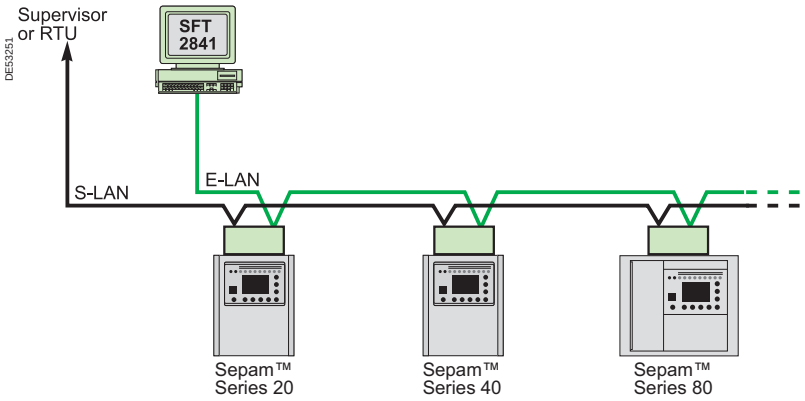
Example 3. Parallel S-LAN and E-LAN networks

S-LAN characteristics

Protocol	Modbus RTU DNP3 or IEC 60870-5-103
Physical medium	2-wire RS485 (twisted-pair) or fiber optic

E-LAN characteristics

Protocol	Modbus RTU
Physical medium	2-wire RS485 (twisted-pair)



Examples of Architectures

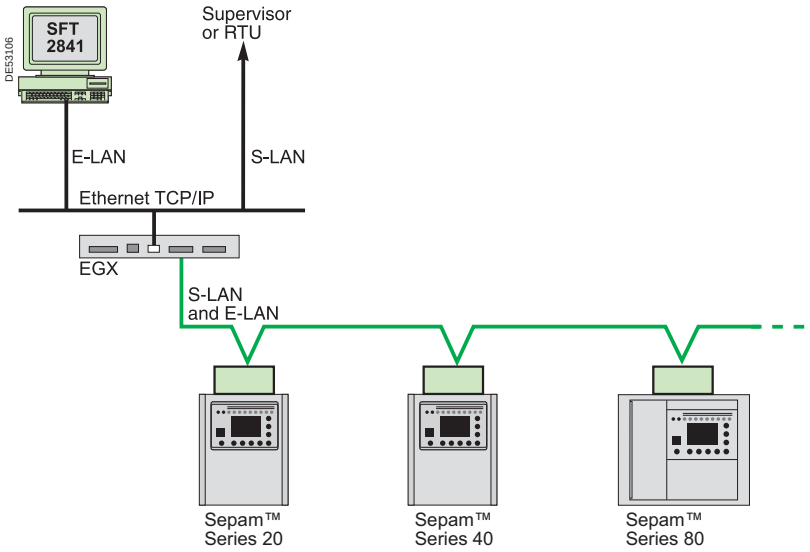
Example 4. S-LAN and E-LAN networks over Ethernet TCP/IP

Characteristics of Modbus network between Sepam relays (S-LAN and E-LAN)

Protocol	Modbus RTU
Physical medium	Twisted-pair (2-wire or 4-wire RS485)

Characteristics of Ethernet network

Protocol	Modbus TCP/IP
Physical medium	Ethernet 10/100 BaseTx or 100 Base Fx
Functions of EGX100 or EGX400 gateway	Modbus TCP / Modbus RTU conversion Multiplexing between S-LAN and E-LAN networks

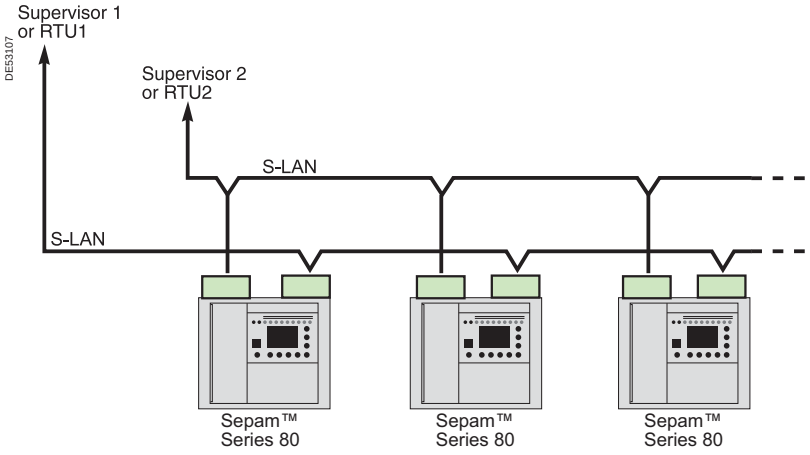


Example 5. Two parallel S-LAN networks (Sepam series 80)

S-LAN characteristics

Protocol	Modbus RTU DNP3 or IEC 60870-5-103
Physical medium	Twisted-pair (2-wire or 4-wire RS485) or fiber optic

Note: *the two communication ports on Sepam series 80 can also be used to create two redundant S-LANs connected to a single supervisor/RTU.*
An E-LAN can be added to the two S-LANs.



Examples of Architectures

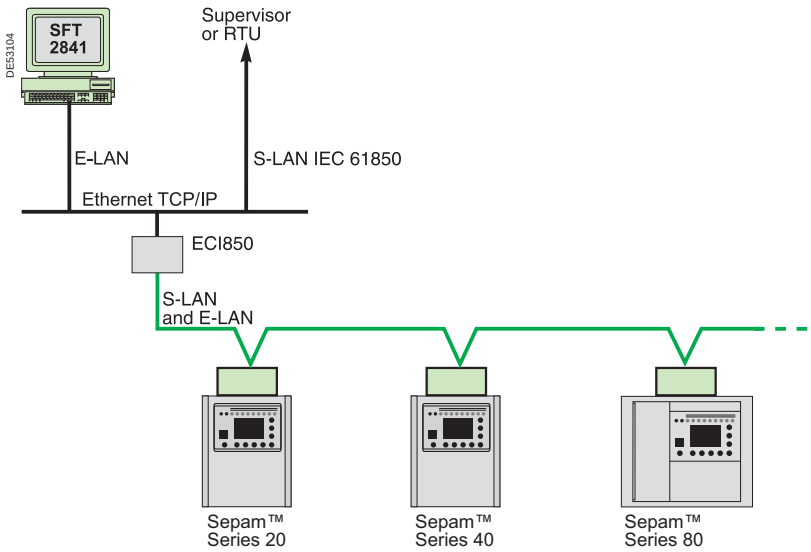
Example 6: S-LAN over IEC 61850 and E-LAN over Ethernet TCP/IP

Characteristics of Modbus network between Sepam relays (S-LAN and E-LAN)

Protocol	Modbus RTU
Physical medium	Twisted-pair (2-wire or 4-wire RS485)

Characteristics of Ethernet network

Protocol	IEC 61850
Support physique	Ethernet 10/100 BaseTx
Sepam ECI850 server functions	Modbus RTU / IEC 61850 conversion Multiplexing between S-LAN and E-LAN networks



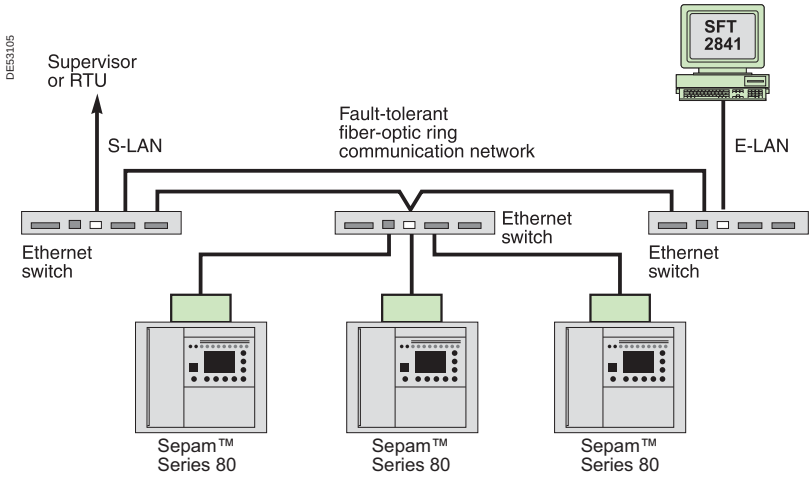
Example 7: S-LAN over IEC 61850 and E-LAN over Ethernet TCP/IP (Sepam series 80)

Characteristics of Ethernet network

Protocol	IEC 61850
Physical medium	Ethernet 10/100 BaseTx or 100 Base Fx

Note: *for the best performance of the protection system when involving peer-to-peer communication through GOOSE messages, we strongly recommend :*

- *to use fiber-optic links*
- *to build a fault-tolerant backbone fiber-optic ring, as shown in the example*
- *to use 61850 compatible managed switches.*



Available Sepam Data
Selection Table

	Modbus RTU			DNP3			IEC 60870-5-103			IEC 61850 (ECI850)		
	Series 20	Series 40	Series 80	Series 20	Series 40	Series 80	Series 20	Series 40	Series 80	Series 20	Series 40	Series 80
Data transmitted from Sepam to the supervisor												
Metering and diagnosis												
Measurements	■	■	■	■	■	■	■	■	■	■	■	■
Energy		■	■		■	■				■	■	■
Network diagnosis	■	■	■	■	■	■				(1)	(1)	(1)
Machine diagnosis	■	■	■	■	■	■				(1)	(1)	(1)
Switchgear diagnosis	■	■	■	■	■	■				(1)	(1)	(1)
Sepam diagnosis	■	■	■	■	■	■	■	■	■	■	■	■
Logipam counters			■			■				■	■	■
Remote indications												
Alarms and internal status conditions	■	■	■	■	■	■	■	■	■	(1)	(1)	(1)
Logic inputs	■	■	■	■	■	■	■	■	■	(1)	(1)	(1)
Logic outputs		■	■							(1)	(1)	(1)
Logic equations		■	■		■	■		■	■	■	■	■
Data transmitted from the supervisor to Sepam												
Pulse-type remote-control commands, in direct mode	■	■	■	■	■	■	■	■	■	(1)	(1)	(1)
Pulse-type remote-control commands, in “Select Before Operate” mode	■	■	■	■	■	■				(1)	(1)	(1)
Maintained remote-control commands (for Logipam)			■							■	■	■
Remote control security			■							■	■	■
Data accessible via special functions												
Time-stamping												
Time-stamped events	■	■	■	■	■	■	■	■	■	■	■	■
Unsolicited events				■	■	■				■	■	■
Time-setting and synchronization	■	■	■	■	■	■	■	■	■	■	■	■
Remote setting												
Selection of the protection-setting group	■	■	■	■	■	■	■	■	■	■	■	■
Reading/writing of protection settings	■	■	■									
Reading of general parameters	■	■	■									
Reading/writing of analog output (MSA141)	■	■	■	■	■	■				■	■	■
Network diagnosis												
Transfer of disturbance-recording data	■	■	■	■	■	■	■	■	■	■	■	■
Tripping contexts		■	■			■			■	(1)	(1)	(1)
Out-of-sync context			■							(1)	(1)	(1)
Miscellaneous												
Identification of Sepam	■	■	■	■	■	■	■	■	■			■
Peer-to-peer data												
Protection related												
Zone Sequence Interlocking (ZSI)												■
Inter-tripping												■
Fast load-shedding												■
User-defined												
Logipam contacts												■

** To or from the Sepam series 80, series 40 and series 20 units, depending on the case.*
***(1)** Depending on the modelling of the IEC 61850 logic nodes.*

Available Sepam Data
Description

Data Transmitted from Sepam to the Supervisor

Metering and Diagnosis
The values measured by Sepam that may be remotely accessed are divided into the following categories:
- measurements: currents, voltages, frequency, power, temperatures, etc.
- energy: calculated or pulse-type energy counters
- network diagnosis: phase displacement, tripping currents, unbalance ratio, etc.
- machine diagnosis: temperature rise, motor starting time, remaining operating time before overload tripping, waiting time after tripping, etc.
- switchgear diagnosis: cumulative breaking current, operating time and number of operations, circuit breaker charging time, etc.
- Sepam diagnosis: partial or major fault, etc.
- Logipam SFT2885 counters.

Remote Indications
The logic-state information that may be remote accessed is divided into the following categories:
- alarms and internal status conditions
- status of logic inputs
- status of logic outputs
- status of nine LEDs on the front panel of Sepam
- status of logic-equation output bits.

Alarms and internal status conditions
The alarms and internal status conditions are remote indications (TS) pre-assigned to protection and control functions. Remote indications depend on the type of Sepam application and can be re-assigned by Logipam. The remote indications that can be accessed via the communication link include:
- all protection-function alarms
- monitoring-function alarms: CT or VT fault, control fault
- Sepam status data:
  - Sepam not reset
  - remote setting blocked, remote-control commands blocked
- status data on the following functions:
  - recloser: in service / blocked, reclosing in progress / successful, permanent trip
  - disturbance recording: records blocked / stored.

Data Transmitted from the Supervisor to Sepam

Pulse-type remote-control commands
Pulse-type remote-control commands (TC) may be carried out in two modes (selected by parameter setting):
- direct mode
- confirmed SBO (select before operate) mode.

Remote-control commands are reassigned to metering, protection and control functions and depend on the type of Sepam. They are used for the following, in particular:
- to control breaking device opening and closing
- to reset Sepam and initialize maximum demand measurements
- to select the active group of settings by enabling group A or B
- to block or enable the following functions: recloser, thermal overload protection, disturbance recording.

Remote-control commands can be re-assigned by Logipam.

Remote-control security
Transmission of Sepam series 80 remote controls and settings over a Modbus S-LAN can be password protected.

Available Sepam Data
Description

IEC 61850 logical nodes

Sepam supports IEC 61850 logical nodes as indicated in the following table. Note that the actual instantiation of each logical node depends on the application.

Nodes		Sepam Series 20 Bus	Sepam Series 20 Others	Sepam Series 40	Sepam Series 80
L: system logical nodes					
LPHD	Physical device information	■	■	■	■
LLN0	Logical node zero	■	■	■	■
P: logical nodes for protection functions					
PDIF	Differential				■
PDOP	Directional overpower			■	■
PDUP	Directional underpower			■	■
PFRC	Rate of change of frequency	■			■
PHIZ	Ground detector				■
PMRI	Motor restart blocking		■	■	■
PMSS	Motor starting time supervision		■	■	■
PSDE	Sensitive directional ground fault			■	■
PTOC	Time overcurrent		■	■	■
PTOF	Overfrequency	■		■	■
PTOV	Overvoltage	■		■	■
PTRC	Protection trip conditioning		■	■	■
PTTR	Thermal overload		■	■	■
PTUC	Undercurrent		■	■	■
PTUV	Undervoltage	■		■	■
PTUF	Underfrequency	■		■	■
PVOC	Voltage controlled time overcurrent			■	■
PVPH	Volts per Hz				■
PZSU	Zero speed or underspeed				■
R: logical nodes for protection related functions					
RBRF	Breaker failure		■	■	■
RREC	Autoreclosing		■	■	■
RSYN	Synchronism-check or synchronizing				■
C: logical nodes for control					
CSWI	Switch controller	■	■	■	■
GG: logical nodes for generic references					
GGIO	Generic process I/O	■	■	■	■
M : logical nodes for metering and measurement					
MHAI	Harmonics or interharmonics				■
MMTR	Metering	■	■	■	■
MMXU	Measurement	■	■	■	■
MSQI	Sequence and imbalance	■		■	■
MSTA	Metering statistics		■	■	■
X: logical nodes for switchgear					
XCBR	Circuit breaker	■	■	■	■
Z: logical nodes for further power system equipment					
ZCAP	Capacitor bank				■

Available Sepam Data
Description

IEC 61850 GOOSE messages
GOOSE messages allows peer-to-peer communication between protection devices in a standardized way. Sepam series 80 with ACE850 communication module supports GOOSE messages for:
- improved system protection:
  - Zone Sequence Interlocking (ZSI)
  - inter-tripping
- improved system control:
  - user-defined Logipam contacts.

High level of performance and security of these messages is ensured by:
- use of fiber optic data link
- use of IEC 61850 compatible managed Ethernet switches
- selection of a fault-tolerant communication architecture

Time-Stamping

Time-stamped events
The time-stamping function assigns a date and precise time to status changes (events) so that they can be accurately organized over time. Sepam systematically time-stamps the following events:
- status changes of all logic inputs
- status changes of all remote indications (TS - alarms and internal status conditions).

Each event is time-stamped to within one millisecond.

The number of stacks of time-stamped events managed by Sepam on each communication port and the volume of each stack in terms of the numbers of events depend on the communication protocol used.

	Modbus RTU	DNP3	IEC 60870-5-103	IEC 61850
Number of event stacks for each Sepam communication port	2	1	1	Depending on configuration
Number of events per stack	64	100	100	Depending on configuration

Whatever the communication protocol used, Modbus RTU, DNP3, IEC 60870-5-103 or IEC 61850 events may be used by a remote monitoring and control system for data logging and histories, for example.

Unsolicited events
Using the DNP3 and IEC 61850 protocols, Sepam can spontaneously transmit time-stamped events to the supervisor. The transmission of unsolicited events must be activated during setup.

Time-setting and synchronization
The Sepam internal clock manages the date and time. Time-setting is possible:
- via the Sepam display
- using the SFT2841 software
- via the communication link.

To ensure long-term time stability or to coordinate a number of devices, Sepam units can be synchronized:
- by an external pulse to a dedicated logic input
- via the communication link.

Available Sepam Data
Description

Remote Setting

Sepam parameter and protection settings
The following remote-setting functions are available:
- selection of the protection-setting group
- reading of general parameters
- reading of protection settings (remote reading)
- writing of protection settings (remote setting).

The writing of protection settings may be blocked by parameter setting.

S-LAN and E-LAN networks
The availability of remote-setting functions over the S-LAN depends on the communication protocol used. All remote-setting functions are available over the E-LAN using the SFT2841 software.

Other Data Accessible via Special Functions

Network diagnosis
The network diagnostic information recorded in files by Sepam can also be transmitted over the communication link:
- disturbance-recording records in COMTRADE format
- tripping contexts
- Out-of-sync context.

Identification of Sepam
The identification function enables the supervisor to clearly identify the device connected to the S-LAN, based on the following elements of information:
- manufacturer identification
- Sepam type.

This function is available for all Sepam relays, whatever the protocol used.

Sepam Series 20 and Sepam Series 40

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Selection Table
Sepam Series 20

		Substation		Transformer		Motor	Bus	
Protection	**ANSI code**	**S20**	**S23**	**T20**	**T23**	**M20**	**B21** [3]	**B22**
Phase overcurrent	50/51	4	4	4	4	4		
Ground fault / Sensitive ground fault	50N/51N 50G/51G	4	4	4	4	4		
Breaker failure	50BF		1		1			
Negative sequence / unbalance	46	1	1	1	1	1		
Thermal overload	49RMS			2	2	2		
Phase undercurrent	37					1		
Excessive starting time, locked rotor	48/51LR/14					1		
Starts per hour	66					1		
Positive sequence undervoltage	27D/47						2	2
Remanent undervoltage	27R						1	1
Line-to-line undervoltage	27						2	2
Line-to-neutral undervoltage	27S						1	1
Line-to-line overvoltage	59						2	2
Neutral voltage displacement	59N						2	2
Overfrequency	81H						1	1
Underfrequency	81L						2	2
Rate of change of frequency	81R							1
Recloser (4 shots)	79	□	□					
Thermostat / Buchholz	26/63			□	□			
Temperature monitoring (8 RTDs)	38/49T			□	□	□		
Metering								
Phase current Ia, Ib, Ic RMS, residual current Ir		■	■	■	■	■		
Demand current Ia, Ib, Ic, maximum demand current Iamax, Ibmax, Icmax		■	■	■	■	■		
Voltage Vab, Vbc, Vca, Van, Vbn, Vcn, residual voltage Vr							■	■
Positive sequence voltage V1 / rotation direction							■	■
Frequency							■	■
Temperature				□	□	□		
Network and machine diagnosis								
Tripping current TripIa, TripIb, TripIc, TripIr		■	■	■	■	■		
Unbalance ratio / negative sequence current I2		■	■	■	■	■		
Disturbance recording		■	■	■	■	■	■	■
Thermal capacity used				■	■	■		
Remaining operating time before overload tripping				■	■	■		
Waiting time after overload tripping				■	■	■		
Running hours counter / operating time				■	■	■		
Starting current and time						■		
Start block time Number of starts before blocking						■		
Switchgear diagnosis								
Cumulative breaking current		■	■	■	■	■		
Trip circuit supervision		□	□	□	□	□	□	□
Number of operations, operating time, charging time		□	□	□	□	□		
Control and monitoring	**ANSI code**							
Circuit breaker / contactor control [1]	94/69	□	□	□	□	□	□	□
Latching / acknowledgement	86	■	■	■	■	■	■	■
Zone Sequence Interlocking (ZSI)	68	□	□	□	□	□		
Switching of groups of settings		■ [2]	■ [2]	■ [2]	■ [2]	■ [2]		
Annunciation	30	■	■	■	■	■	■	■
Additional modules								
8 temperature sensor inputs - MET1482 module				□	□	□		
1 low level analog output - MSA141 module		□	□	□	□	□	□	□
Logic inputs/outputs - MES114/MES114E/MES114F (10I/4O) module		□	□	□	□	□	□	□
Communication interface - ACE9492, ACE959, ACE937, ACE969TP or ACE969FO		□	□	□	□	□	□	□

■ *standard* □ *according to parameter setting and MES114/MES114E/MES114F or MET1482 input/output module options.*
(1) *For NO or NC trip contacts.*
(2) *Exclusive choice between Zone Sequence Interlocking (ZSI) and switching from one 2-relay group of settings to another 2-relay group.*
(3) *Performs Sepam B20 functions.*
(4) *the digits in the matrix to the right of the ANSI code indicate the number of units available for each protection function.*

Selection Table
Sepam Series 40

		Substation		Transformer	Motor			Generator
Protection	**ANSI code**	**S40**	**S41**	**S42**	**T40**	**T42**	**M41**	**G40**
Phase overcurrent	50/51	4	4	4	4	4	4	4
Voltage-restrained overcurrent	50V/51V							1
Ground fault / Sensitive ground fault	50N/51N 50G/51G	4	4	4	4	4	4	4
Breaker failure	50BF	1	1	1	1	1	1	1
Negative sequence / unbalance	46	2	2	2	2	2	2	2
Directional phase overcurrent	67			2		2		
Directional ground fault	67N/67NC		2	2		2	2	
Directional active overpower	32P		1	1			1	1
Directional reactive overpower	32Q/40						1	1
Thermal overload	49RMS				2	2	2	2
Phase undercurrent	37						1	
Excessive starting time, locked rotor	48/51LR/14						1	
Starts per hour	66						1	
Positive sequence undervoltage	27D						2	
Remanent undervoltage	27R						1	
Undervoltage (3)	27/27S	2	2	2	2	2	2	2
Overvoltage (3)	59	2	2	2	2	2	2	2
Neutral voltage displacement	59N	2	2	2	2	2	2	2
Negative sequence overvoltage	47	1	1	1	1	1	1	1
Overfrequency	81H	2	2	2	2	2	2	2
Underfrequency	81L	4	4	4	4	4	4	4
Recloser (4 shots)	79	□	□	□				
Temperature monitoring (8 or 16 RTDs)	38/49T				□	□	□	□
Thermostat / Buchholz	26/63				□	□		
Metering								
Phase current Ia, Ib, Ic RMS, residual current Ir		■	■	■	■	■	■	■
Demand current Ia, Ib, Ic, maximum demand current Iamax, Ibmax, Icmax		■	■	■	■	■	■	■
Voltage Vab, Vbc, Vca, Van, Vbn, Vcn, residual voltage Vr		■	■	■	■	■	■	■
Positive sequence voltage V1 / rotation direction Negative sequence voltage V2		■	■	■	■	■	■	■
Frequency		■	■	■	■	■	■	■
Active, reactive and apparent power P, Q, S Maximum demand power Pmax, Qmax, power factor		■	■	■	■	■	■	■
Calculated active and reactive energy (±W.h, ±var.h)		■	■	■	■	■	■	■
Active and reactive energy by pulse counting (±W.h, ±.varh)		□	□	□	□	□	□	□
Temperature					□	□	□	□
Network and machine diagnosis								
Tripping context		■	■	■	■	■	■	■
Tripping current TripIa, TripIb, TripIc, TripIr		■	■	■	■	■	■	■
Unbalance ratio / negative sequence current I2		■	■	■	■	■	■	■
Phase displacement φ0, φa, φb, φc		■	■	■	■	■	■	■
Disturbance recording		■	■	■	■	■	■	■
Thermal capacity used					■	■	■	■
Remaining operating time before overload tripping					■	■	■	■
Waiting time after overload tripping					■	■	■	■
Running hours counter / operating time					■	■	■	■
Starting current and time							■	
Start block time, number of starts before blocking							■	
Switchgear diagnosis								
Cumulative breaking current		■	■	■	■	■	■	■
Trip circuit supervision		□	□	□	□	□	□	□
Number of operations, operating time, charging time		□	□	□	□	□	□	□
CT / VT supervision	60FL	■	■	■	■	■	■	■
Control and monitoring	**ANSI code**							
Circuit breaker / contactor control (1)	94/69	■	■	■	■	■	■	■
Latching / acknowledgement	86	■	■	■	■	■	■	■
Zone Sequence Interlocking (ZSI)	68	□	□	□	□	□	□	□
Switching of groups of settings		■	■	■	■	■	■	■
Annunciation	30	■	■	■	■	■	■	■
Logic equation editor		■	■	■	■	■	■	■
Additional modules								
8 temperature sensor inputs - MET1482 module (2)					□	□	□	□
1 low level analog output - MSA141 module		□	□	□	□	□	□	□
Logic inputs/outputs - MES114/MES114E/MES114F (10I/4O) module		□	□	□	□	□	□	□
Communication interface - ACE9492, ACE959, ACE937, ACE969TP, ACE969FO or ECI850		□	□	□	□	□	□	□

■ *standard* □ *according to parameter setting and MES114/MES114E/MES114F or MET1482 input/output module options.*

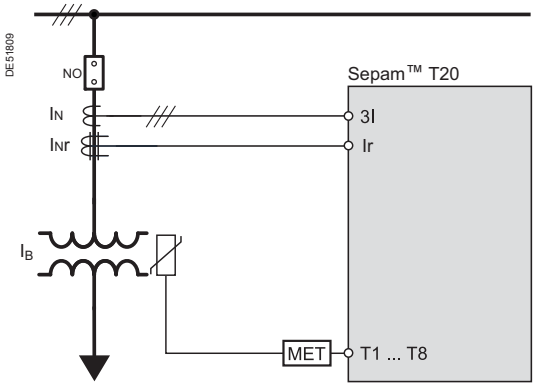
(1) *For NO or NC trip contacts.*

(2) *2 modules possible.*

(3) *Exclusive choice, line-to-neutral voltage or line-to-line voltage for each of the 2 relays.*

(4) *the digits in the matrix to the right of the ANSI code indicate the number of units available for each protection function.*

Sensor Inputs

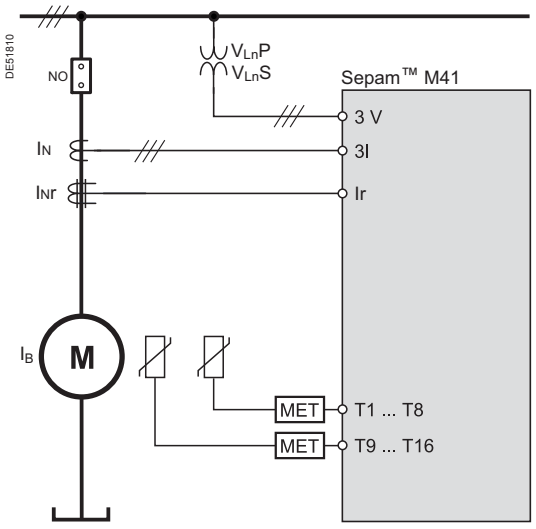


Sepam T20 sensor inputs.

Each Sepam series 20 or Sepam series 40 has analog inputs that are connected to the measurement sensors required for the application.

Sepam Series 20 Sensor Inputs

	S20, S23	T20, T23, M20	B21, B22
Phase current inputs	3	3	0
Residual current input	1	1	0
Phase voltage inputs	0	0	3
Residual voltage input	0	0	1
Temperature inputs (on MET1482 module)	0	8	0



Sepam M41 sensor inputs.

Sepam Series 40 Sensor Inputs

	S40, S41, S42		T40, T42, M41, G40	
Phase current inputs	3		3	
Residual current input	1		1	
Phase voltage inputs	2	3	2	3
Residual voltage input	1	0	1	0
Temperature inputs (on MET1482 module)	0		2 x 8	

General Settings

The general settings define the characteristics of the measurement sensors connected to Sepam and determine the performance of the metering and protection functions used. They are accessed via the SFT2841 setting software “General Characteristics”, “CT-VT Sensors” and “Particular characteristics” tabs.

General settings		Selection	Sepam Series 20	Sepam Series 40
I_N	Rated phase current (sensor primary current)	2 or 3 CT 1 A / 5 A	1 A to 6250 A	1 A to 6250 A
		3 LPCTs	25 A to 3150 A (1)	25 A to 3150 A (1)
I_B	Base current, according to rated power of equipment		0.4 to 1.3 I_N	0.4 to 1.3 I_N
I_{Nr}	Rated residual current	Sum of 3-phase currents	See I_N rated phase current	See I_N rated phase current
		CSH120 or CSH200 zero sequence CT	2 A or 20 A rating	2 A, 5 A or 20 A rating
		1 A/5 A CT + CSH30 interposing ring CT	1 A to 6250 A	1 A to 6250 A (I_{Nr} = I_N)
		1 A/5 A CT + CSH30 interposing ring CT Sensitivity x10	-	1 A to 6250 A (I_{Nr} = I_N/10)
		Zero sequence CT + ACE990 (the zero sequence CT ratio 1/n must be such that 50 y n y 1500)	According to current monitored and use of ACE990	According to current monitored and use of ACE990
$V_{LL}p$	Rated primary line-to-line voltage ($V_{Ln}p$: rated primary line-to-neutral voltage $V_{Ln}p = V_{LL}p/3$)		220 V to 250 kV	220 V to 250 kV
$V_{LL}s$	Rated secondary line-to-line voltage	3 VTs: Van, Vbn, Vcn	100, 110, 115, 120, 200, 230 V	100, 110, 115, 120, 200, 230 V
		2 VTs: Vab, Vbc	100, 110, 115, 120 V	100, 110, 115, 120 V
		1 VT: Van	100, 110, 115, 120 V	100, 110, 115, 120 V
$V_{LL}sr$	Secondary zero sequence voltage relative to primary zero sequence voltage $V_{LL}np/3$		$V_{LL}ns/3$ or $V_{LL}ns/\sqrt{3}$	$V_{LL}ns/3$ or $V_{LL}ns/\sqrt{3}$
	Rated frequency		50 Hz or 60 Hz	50 Hz or 60 Hz
	Demand interval (for demand current and maximum demand current and power)		5, 10, 15, 30, 60 min	5, 10, 15, 30, 60 min
	Pulse-type accumulated energy meter	Increments active energy	-	0.1 kW.h to 5 MW.h
		Increments reactive energy	-	0.1 kvar.h to 5 Mvar.h

(1) I_N *values for LPCT, in Amps: 25, 50, 100, 125, 133, 200, 250, 320, 400, 500, 630, 666, 1000, 1600, 2000, 3150.*

Metering

Sepam is a precision metering unit. All the metering and diagnosis data used for commissioning and required for the operation and maintenance of your equipment are available locally or remotely, expressed in the units concerned (A, V, W, etc.).

Phase current

RMS current for each phase, taking into account harmonics up to number 13.
Different types of sensors may be used to meter phase current:
- 1 A or 5 A current transformers
- LPCT type current sensors.

Residual current

Two residual current values are available depending on the type of Sepam and sensors connected to it:
- residual currents IrΣ, calculated by the vector sum of the 3-phase currents
- measured residual current Ir.

Different types of sensors may be used to measure residual current:
- CSH120 or CSH200 specific zero sequence CT
- conventional 1 A or 5 A current transformer
- any zero sequence CT with an ACE990 interface.

Demand current and maximum demand currents

Demand current and maximum demand currents are calculated according to the 3-phase currents Ia, Ib and Ic:
- demand current is calculated over an adjustable period of 5 to 60 minutes
- maximum demand current is the greatest demand current and indicates the current drawn by maximum loads.

Maximum demand currents may be cleared.

Voltage and frequency

The following measurements are available according to the voltage sensors connected:
- line-to-neutral voltages Van, Vbn, Vcn
- line-to-line voltages Vab, Vbc, Vca
- residual voltage Vr
- positive sequence voltage V1 and negative sequence voltage V2
- frequency f.

Power

Powers are calculated according to the phase currents Ia, Ib and Ic:
- active power
- reactive power
- apparent power
- power factor (pf).

Power calculation is based on the 2 wattmeter method. The 2 wattmeter method is only accurate when there is no residual current and it is not applicable if the neutral is distributed.

Maximum demand powers

The greatest demand active and reactive power values calculated over the same period as the demand current. The maximum demand powers may be cleared.

Energy

- 4 accumulated energies calculated according to voltages and phase currents measured: active energy and reactive energy in both directions
- 1 to 4 additional accumulated energy meters for the acquisition of active or reactive energy pulses from external meters.

Temperature

Accurate measurement of temperature inside equipment fitted with Pt100, Ni100 or Ni120 type RTDs, connected to the optional remote MET1482 module.

Machine Diagnosis Assistance

Sepam assists facility managers by providing:
- data on the operation of their machines
- predictive data to optimize process management
- useful data to facilitate protection function setting and implementation.

Thermal capacity used

Equivalent temperature buildup in the machine, calculated by the thermal overload protection function. Displayed as a percentage of rated thermal capacity.

Remaining operating time before overload tripping

Predictive data calculated by the thermal overload protection function. The time is used by facility managers to optimize process management in real time by deciding to:
- interrupt according to procedures
- continue operation with blocking of thermal protection on overloaded machine.

Waiting time after overload tripping

Predictive data calculated by the thermal overload protection function. Waiting time to avoid further tripping of thermal overload protection by premature re-energizing of insufficiently cooled down equipment.

Running hours counter / operating time

Equipment is considered to be running whenever a phase current is over 0.1 I_B. Cumulative operating time is given in hours.

Motor starting / overload current and time

A motor is considered to be starting or overloaded when a phase current is over 1.2 I_B. For each start / overload, Sepam stores:
- maximum current drawn by the motor
- starting / overload time.

The values are stored until the next start / overload operation.

Number of starts before blocking/start block time

Indicates the number of starts still allowed by the starts per hour protection function. If the number is zero, it indicates only one start is allowed.

Network Diagnosis Assistance

Sepam provides network power quality metering functions, and all the data on network disturbances detected by Sepam are recorded for analysis purposes.

Tripping context

Storage of tripping currents and Ir, I2, Vab, Vbc, Vca, Vr, V2, V1, f, P and Q values when tripping occurs. The values for the last five trips are stored.

Tripping current

Storage of the 3-phase currents and ground fault current at the time of the last Sepam trip command, to indicate fault current. The values are stored in the tripping contexts.

Negative sequence / unbalance

Negative sequence component of phase currents Ia, Ib and Ic, indicating the degree of unbalance in the power supplied to the protected equipment.

Phase displacement

- phase displacement φa, φb, φc between phase currents I1, I2, I3 and voltages Van, Vbn, Vcn respectively
- phase displacement φr between residual current and residual voltage.

Disturbance recording

Recording triggered by user-set events:
- all sampled values of measured currents and voltages
- status of all logic inputs and outputs
- logic data: instantaneous, etc.

Characteristics	Sepam Series 20	Sepam Series 40
Number of recordings in COMTRADE format	2	Adjustable from 1 to 19
Total duration of a recording	86 periods (1.72 s at 50 Hz, 1.43 s at 60 Hz)	Adjustable from 1 to 10 s. The total of all the records plus one must not be more than 20 s at 50 Hz and 16 s at 60 Hz
Number of samples per period	12	12
Duration of recording before occurrence of the event	Adjustable from 0 to 86 periods	Adjustable from 0 to 99 periods
Recorded data	■ currents or voltages ■ logic inputs ■ pick up ■ logic output O1.	■ currents and voltages ■ logic inputs ■ pick up ■ logic outputs O1 to O4.

Metering and Diagnosis
Description

Sepam Self-Diagnosis

Sepam includes a number of self-tests carried out in the base unit and optional modules. The purpose of the self-tests is to:
- detect internal failures that may cause nuisance tripping or failed fault tripping
- put Sepam in fail-safe position to avoid any unwanted operation
- alert the facility manager of the need for maintenance operations.

Internal failure

Two categories of internal failures are monitored:
- major failures: Sepam shutdown (to fail-safe position). The protection functions are blocked, the output relays are forced to drop out and the “Watchdog” output indicates Sepam shutdown
- minor failures: downgraded Sepam operation. Sepam’s main functions are operational and equipment protection is ensured.

Detection of plugged connectors

The system checks that the current or voltage sensors are plugged in. A missing connector is a major failure.

Configuration checking

The system checks that the optional modules configured are present and working correctly. The absence or failure of a remote module is a minor failure, the absence or failure of a logic input/output module is a major failure.

Switchgear Diagnosis Assistance

Switchgear diagnosis data give facility managers information on:
- mechanical condition of breaking device
- Sepam auxiliaries and assist them for preventive and curative switchgear maintenance actions.

The data are to be compared to switchgear manufacturer data.

ANSI 60/60FL - CT/VT supervision

Used to monitor the entire metering chain:
- CT and VT sensors
- connection
- Sepam analog inputs.

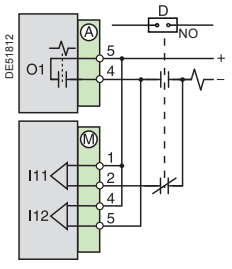
Monitoring includes:
- consistency checking of currents and voltages measured
- acquisition of phase or residual voltage transformer protection fuse blown contacts.

In the event of a loss of current or voltage measurement data, the assigned protection functions may be blocked to avoid nuisance tripping.

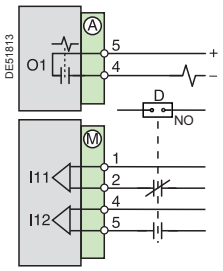
ANSI 74 - Trip circuit supervision

To determine the health of the trip circuit, Sepam monitors:
- shunt trip coil connection
- matching of breaking device open/closed position contacts
- execution of breaking device open and close commands.

The trip circuit is only supervised when connected as shown below.



Connection for shunt trip coil monitoring.



Connection for undervoltage trip coil monitoring.

Cumulative breaking current

Six cumulative currents are proposed to assess the pole condition of the breaking device:
- total cumulative breaking current
- cumulative breaking current between 0 and 2 I_N
- cumulative breaking current between 2 I_N and 5 I_N
- cumulative breaking current between 5 I_N and 10 I_N
- cumulative breaking current between 10 I_N and 40 I_N
- cumulative breaking current > 40 I_N.

Each time the breaking device opens, the breaking current is added to the cumulative total and to the appropriate range of cumulative breaking current. Cumulative breaking current is given in $(kA)^2$.

Number of operations

Cumulative number of opening operations performed by the breaking device.

Circuit breaker operating time and charging time

Used to assess the condition of the operating mechanism of the breaking device.

Metering and Diagnosis
Characteristics

Functions		Measurement Range	Accuracy (1) Sepam Series 20	Accuracy (1) Sepam Series 40	MSA141	Saving
Metering						
Phase current		0.1 to 40I_N(3)	±1 %	±0.5 %	■	
Residual current	Calculated	0.1 to 40 I_N	±1 %	±1 %	■	
	Measured	0.1 to 20 I_{Nr}	±1 %	±1 %	■	
Demand current		0.1 to 40 I_N	±1 %	±0.5 %		
Maximum demand current		0.1 to 40 I_N	±1 %	±0.5 %		□
Line-to-line voltage		0.05 to 1.2 $V_{LL}p$	±1 %	±0.5 %	■	
Line-to-neutral voltage		0.05 to 1.2 $V_{Ln}p$	±1 %	±0.5 %	■	
Residual voltage		0.015 to 3 $V_{Ln}p$	±1 %	±1 %		
Positive sequence voltage		0.05 to 1.2 $V_{Ln}p$	±5 %	±2 %		
Negative sequence voltage		0.05 to 1,2 $V_{Ln}p$	-	±2 %		
Frequency Sepam series 20		50 ±5 Hz or 60 ±5 Hz	±0.05 Hz	-	■	
Frequency Sepam series 40		25 to 65 Hz	-	±0.02 Hz	■	
Active power		0.015 Sn(2) to 999 MW	-	±1 %	■	
Reactive power		0.015 Sn(2) to 999 Mvar	-	±1 %	■	
Apparent power		0.015 Sn(2) to 999 MVA	-	±1 %	■	
Maximum demand active power		0.015 Sn(2) to 999 MW	-	±1 %		□
Maximum demand reactive power		0.015 Sn(2) to 999 Mvar	-	±1 %		□
Power factor		-1 to +1 (CAP/IND)	-	±1 %		
Calculated active energy		0 to 2.1.10^8 MW.h	-	±1 % ±1 digit		□
Calculated reactive energy		0 to 2.1.10^8 Mvar.h	-	±1 % ±1 digit		□
Temperature		-30 to +200 °C or -22 to +392 °F	±1 °C from +20 to +140 °C ±1 °F from +68 to +284 °F	±1 °C from +20 to +140 °C ±1 °F from +68 to +284 °F	■	
Network diagnosis assistance						
Tripping context						□
Phase tripping current		0.1 to 40 I_N	±5 %	±5 %		□
Ground fault tripping current		0.1 to 20 I_{Nr}	±5 %	±5 %		□
Negative sequence / unbalance		10 to 500 % of I_B	±2 %	±2 %		
Phase displacement 0 (between Vr and Ir)		0 to 359°	-	±2°		
Phase displacement 1, 2, 3 (between V and I)		0 to 359°	-	±2°		
Machine operating assistance						
Thermal capacity used		0 to 800 % (100 % for I phase = I_B)	±1 %	±1 %	■	□
Remaining operating time before overload tripping		0 to 999 min	±1 min	±1 min		
Waiting time after overload tripping		0 to 999 min	±1 min	±1 min		
Running hours counter / operating time		0 to 65535 hours	±1 % or ±0.5 h	±1 % or ±0.5 h		□
Starting current		1.2 I_B to 24 I_N	±5 %	±5 %		□
Starting time		0 to 300 s	±300 ms	±300 ms		□
Number of starts before blocking		0 to 60	1	1		
Start block time		0 to 360 min	±1 min	±1 min		
Cooling time constant		5 to 600 min	-	±5 min		
Switchgear diagnosis assistance						
Cumulative breaking current		0 to 65535 kA²	±10 %	±10 %		□
Number of operations		0 to 4.10^9	1	1		□
Operating time		20 to 100 ms	±1 ms	±1 ms		□
Charging time		1 to 20 s	±0.5 s	±0.5 s		□

■ *available on MSA141 analog output module, according to setup.*
□ *saved in the event of auxiliary supply outage.*
(1) *Under reference conditions (IEC 60255-6), typical accuracy at* I_N *or* $V_{LL}p$, *pf > 0.8.*
(2) *Sn: apparent power,* $= 3.V_{LL}p.I_N$.
(3) *Measurement up to 0.02* I_N *for information purpose.*

2

Current Protection Functions

ANSI 50/51 - Phase overcurrent

Line-to-line short-circuit protection, sensitive to the highest phase current measured.

Characteristics

- 2 groups of settings
- instantaneous or time-delayed tripping
- definite time (DT) or IDMT curve (choice of 16 standardized IDMT curves)
- with or without timer hold

With Sepam series 40, tripping can be confirmed or unconfirmed, according to parameter setting:

- unconfirmed tripping: standard
- tripping confirmed by negative sequence overvoltage protection (ANSI 47, unit 1), as backup for distant 2-phase short-circuits
- tripping confirmed by undervoltage protection (ANSI 27, unit 1), as backup for line-to-line short-circuits in networks with low short-circuit power.

ANSI 50N/51N or 50G/51G - Ground fault

Ground fault protection based on measured or calculated residual current values:

- ANSI 50N/51N: residual current calculated or measured by 3-phase current sensors
- ANSI 50G/51G: residual current measured directly by a specific sensor.

Characteristics

- 2 groups of settings
- Definite time (DT) or IDMT curve (choice of 16 standardized IDMT curves)
- with or without timer hold
- second harmonic restraint to ensure stability during transformer energizing, activated by parameter setting.

ANSI 50BF - Breaker failure

If a breaker fails to be triggered by a tripping command, as detected by the non-extinction of the fault current, this backup protection sends a tripping command to the upstream or adjacent breakers.

ANSI 46 - Negative sequence / unbalance

Protection against phase unbalance, detected by the measurement of negative sequence current:

- sensitive protection to detect 2-phase faults at the ends of long lines
- protection of equipment against temperature build-up, caused by an unbalanced power supply, phase inversion or loss of phase, and against phase current unbalance.

Characteristics

- Sepam series 20:
  - 1 definite time (DT) curve
  - 1 specific Schneider IDMT curve.
- Sepam series 40:
  - 1 definite time (DT) curve
  - 7 IDMT curves: 3 IEC curves, 3 IEEE curves and 1 specific Schneider curve.

ANSI 49RMS - Thermal overload

Protection against thermal damage caused by overloads on machines (transformers, motors or generators). The thermal capacity used is calculated according to a mathematical model which takes into account:

- current RMS values
- ambient temperature
- negative sequence current, a cause of motor rotor temperature rise.

The thermal capacity used calculations may be used to calculate predictive data for process control assistance. The protection may be blocked by a logic input when required by process control conditions.

Characteristics

- 2 groups of settings
- 1 adjustable alarm set point
- 1 adjustable tripping set point
- adjustable initial thermal capacity used setting, to adapt protection characteristics to fit manufacturer's thermal withstand curves
- equipment heating and cooling time constants.
  With Sepam series 40, the cooling time constant may be calculated automatically based on measurement of the equipment temperature by a sensor.

Recloser

ANSI 79

Automation device used to limit down time after tripping due to transient or semi-permanent faults on overhead lines. The recloser automatically recloses the breaking device after the insulation restoring time delay. Recloser operation is easy to adapt for different operating modes by parameter setting.

Characteristics

- 1 to 4 reclosing shots, each shot has an adjustable "dead time;" and adjustable independent "reclaim time" and "blocking time" until recloser ready
- shot activation linked to instantaneous or time-delayed short-circuit protection function (ANSI 50/51, 50N/51N, 67, 67N/67NC) outputs by parameter setting
- blocking/lockout of recloser by logic input.

Directional Current Protection

ANSI 67 - Directional phase overcurrent

Line-to-line short-circuit protection, with selective tripping according to fault current direction. It comprises a phase overcurrent function associated with direction detection, and picks up if the phase overcurrent function in the chosen direction (line or bus) is activated for at least one of the 3 phases.

Characteristics

- 2 groups of settings
- instantaneous or time-delayed tripping
- choice of tripping direction
- definite time (DT) or IDMT curve (choice of 16 standardized IDMT curves)
- with voltage memory to make the protection insensitive to loss of polarization voltage at the time of the fault
- with or without timer hold.

ANSI 67N/67NC - Directional ground fault

Ground fault protection, with selective tripping according to fault current direction.
3 types of operation:

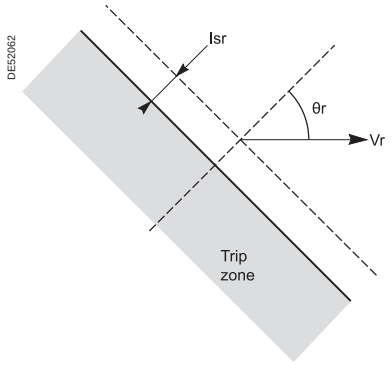
- type 1: the protection function uses the projection of the Ir vector
- type 2: the protection function uses the Ir vector magnitude with half-plane tripping zone
- type 3: the protection function uses the Ir vector magnitude with angular sector tripping zone

ANSI 67N/67NC type 1

Directional ground fault protection for impedance, isolated or compensated neutral systems, based on the projection of measured residual current.

Type 1 characteristics

- 2 groups of settings
- instantaneous or time-delayed tripping
- definite time (DT) curve
- choice of tripping direction
- characteristic projection angle
- no timer hold
- with voltage memory to make the protection insensitive to recurrent faults in compensated neutral systems.



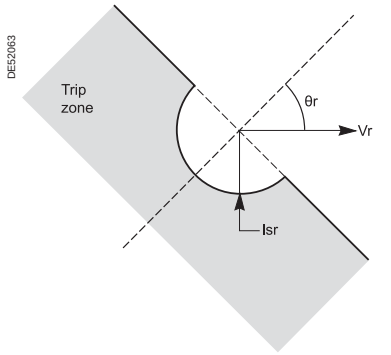
Tripping characteristic of ANSI 67N/67NC type 1 protection (characteristic angle θr 0°).

ANSI 67N/67NC type 2

Directional overcurrent protection for impedance and solidly grounded systems, based on measured or calculated residual current. It comprises a ground fault function associated with direction detection, and picks up if the ground fault function in the chosen direction (line or bus) is activated.

Type 2 characteristics

- 2 groups of settings
- instantaneous or time-delayed tripping
- definite time (DT) or IDMT curve (choice of 16 standardized IDMT curves)
- choice of tripping direction
- with or without timer hold.



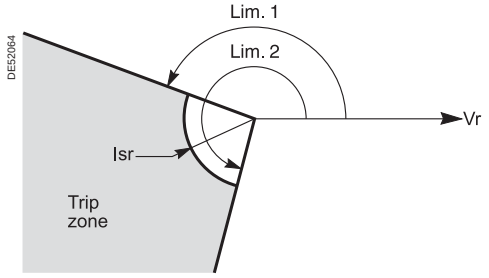
Tripping characteristic of ANSI 67N/67NC type 2 protection (characteristic angle θr 0°).

ANSI 67N/67NC type 3

Directional overcurrent protection for distribution networks in which the neutral grounding system varies according to the operating mode, based on measured residual current. It comprises a ground fault function associated with direction detection (angular sector tripping zone defined by 2 adjustable angles), and picks up if the ground fault function in the chosen direction (line or bus) is activated.
This protection function complies with the Enel DK5600 specification.

Type 3 characteristics

- 2 groups of settings
- instantaneous or time-delayed tripping
- definite time (DT) curve
- choice of tripping direction
- no timer hold



Tripping characteristic of ANSI 67N/67NC type 3 protection.

2

Directional Power Protection Functions

ANSI 32P - Directional active overpower

Two-way protection based on calculated active power, for the following applications:

- active overpower protection to detect overloads and allow load shedding
- reverse active power protection:
  - against generators running like motors when the generators consume active power
  - against motors running like generators when the motors supply active power.

ANSI 32Q/40 - Directional reactive overpower

Two-way protection based on calculated reactive power to detect field loss on synchronous machines:

- reactive overpower protection for motors which consume more reactive power with field loss
- reverse reactive overpower protection for generators which consume reactive power with field loss.

Machine Protection Functions

ANSI 37 - Phase undercurrent

Protection of pumps against the consequences of a loss of priming by the detection of motor no-load operation. It is sensitive to a minimum of current in phase 1, remains stable during breaker tripping and may be blocked by a logic input.

ANSI 48/51LR/14 - Locked rotor / excessive starting time

Protection of motors against overheating caused by:

- excessive motor starting time due to overloads (e.g. conveyor) or insufficient supply voltage. The reacceleration of a motor that is not shut down, indicated by a logic input, may be considered as starting.
- locked rotor due to motor load (e.g. crusher):
  - in normal operation, after a normal start
  - directly upon starting, before the detection of excessive starting time, with detection of locked rotor by a zero speed detector connected to a logic input, or by the underspeed function.

ANSI 66 - Starts per hour

Protection against motor overheating caused by:

- too frequent starts: motor energizing is blocked when the maximum allowable number of starts is reached, after counting of:
  - starts per hour (or adjustable period)
  - consecutive motor hot or cold starts (reacceleration of a motor that is not shut down, indicated by a logic input, may be counted as a start)
- starts too close together in time: motor re-energizing after a shutdown is only allowed after an adjustable waiting time.

ANSI 50V/51V - Voltage-restrained overcurrent

Line-to-line short-circuit protection for generators. The current tripping set point is voltage-adjusted in order to be sensitive to faults close to the generator which cause voltage drops and lowers the short-circuit current.

Characteristics

- instantaneous or time-delayed tripping
- definite time (DT) or IDMT curve (choice of 16 standardized IDMT curves)
- with or without timer hold.

ANSI 26/63 - Thermostat/Buchholz

Protection of transformers against temperature rise and internal faults via logic inputs linked to devices integrated in the transformer.

ANSI 38/49T - Temperature monitoring

Protection that detects abnormal temperature build-up by measuring the temperature inside equipment fitted with sensors:

- transformer: protection of primary and secondary windings
- motor and generator: protection of stator windings and bearings.

Characteristics

- Sepam series 20: 8 Pt100, NI100 or Ni120 type RTDs
- Sepam series 40: 16 Pt100, NI100 or Ni120 type RTDs
- 2 adjustable independent set points for each RTD (alarm and trip).

Voltage Protection Functions

ANSI 27D - Positive sequence undervoltage
Protection of motors against faulty operation due to insufficient or unbalanced network voltage, and detection of reverse rotation direction.

ANSI 27R - Remanent undervoltage
Protection used to check that remanent voltage sustained by rotating machines has been cleared before allowing the bus supplying the machines to be re-energized, to avoid electrical and mechanical transients.

ANSI 27 - Undervoltage
Protection of motors against voltage sags or detection of abnormally low network voltage to trigger automatic load shedding or source transfer. Works with line-to-line voltage (Sepam series 20 and Sepam series 40) or line-to-neutral voltage (Sepam series 40 only), each voltage being monitored separately.

ANSI 59 - Overvoltage
Detection of abnormally high network voltage or checking for sufficient voltage to enable source transfer. Works with line-to-line or line-to-neutral voltage, each voltage being monitored separately.

ANSI 59N - Neutral voltage displacement
Detection of insulation faults by measuring residual voltage in isolated neutral systems.

ANSI 47 - Negative sequence overvoltage
Protection against phase unbalance resulting from phase inversion, unbalanced supply or distant fault, detected by the measurement of negative sequence voltage.

Frequency Protection Functions

ANSI 81H - Overfrequency
Detection of abnormally high frequency compared to the rated frequency, to monitor power supply quality.

ANSI 81L - Underfrequency
Detection of abnormally low frequency compared to the rated frequency, to monitor power supply quality. The protection may be used for overall tripping or load shedding. Protection stability is ensured in the event of the loss of the main source and presence of remanent voltage by a continuous decrease of the frequency, which is activated by parameter setting.

ANSI 81R - Rate of change of frequency
Protection function used for fast disconnection of a generator or load shedding control. Based on the calculation of the frequency variation, it is insensitive to transient voltage disturbances and therefore more stable than a phase-shift protection function.

Disconnection
In installations with autonomous production means connected to a utility, the “rate of change of frequency” protection function is used to detect loss of the main system in view of opening the incoming circuit breaker to:
- protect the generators from a reconnection without checking synchronization
- avoid supplying loads outside the installation.

Load shedding
The “rate of change of frequency” protection function is used for load shedding in combination with the underfrequency protection to:
- either accelerate shedding in the event of a large overload
- or block shedding following a sudden drop in frequency due to a problem that should not be solved by shedding.

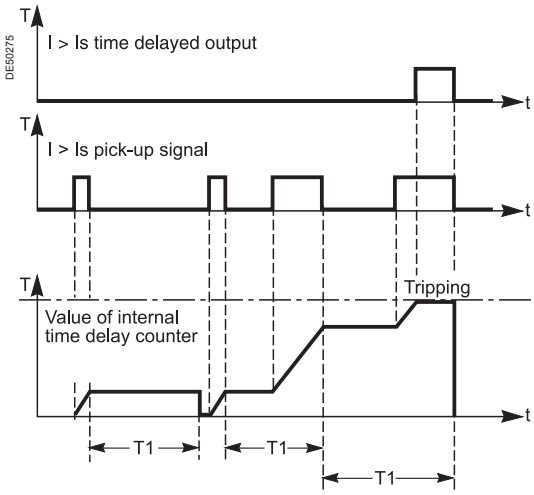
Current IDMT Tripping Curves

Multiple IDMT tripping curves are offered, to cover most applications:
- IEC curves (SIT, VIT/LTI, EIT)
- IEEE curves (MI, VI, EI)
- usual curves (UIT, RI, IAC).

The curve equations are given page 94.

Setting of IDMT Tripping Curves, Time Delay T or TMS Factor

The time delays of current IDMT tripping curves (except for customized and RI curves) may be set as follows:
- time T, operating time at 10 x Is
- TMS factor, factor shown as T/β (see curve equation page 94).



Detection of restriking faults with adjustable timer hold.

Timer Hold

The adjustable timer hold T1 is used for:
- detection of restriking faults (DT curve)
- coordination with electromechanical relays (IDMT curve).

Timer hold may be blocked if necessary.

2 Groups of Settings

Line-to-line and line-to-ground short-circuit protection

Each unit has 2 groups of settings, A and B, to adapt the settings to suit the network configuration. The active group of settings (A or B) is set by a logic input or the communication link.

Example of use: normal / backup mode network
- group A for network protection in normal mode, when the network is supplied by the utility
- group B for network protection in backup mode, when the network is supplied by a backup generator.

Thermal overload for machines

Each unit has 2 groups of settings to protect equipment that has two operating modes.

Examples of use:
- transformers: switching of groups of settings by logic input, according to transformer ventilation operating mode, natural or forced ventilation (ONAN or ONAF)
- motors: switching of groups of settings according to current set point, to take into account the thermal withstand of motors with locked rotors.

Summary Table

Characteristics	Protection Functions
2 groups of settings A and B	50/51, 50N/51N, 67, 67N/67NC
2 groups of settings, operating modes 1 and 2	49RMS Machine
IEC IDMT curves	50/51, 50N/51N, 50V/51V, 67, 67N/67NC type 2, 46
IEEE IDMT curves	50/51, 50N/51N, 50V/51V, 67, 67N/67NC type 2, 46
Usual IDMT curves	50/51, 50N/51N, 50V/51V, 67, 67N/67NC type 2
Timer hold	50/51, 50N/51N, 50V/51V, 67, 67N/67NC type 2

Protection
Setting Ranges

Functions	Settings		Time Delays
ANSI 27 - Line-to-line undervoltage			
	5 to 100 % of $V_{LL}p$		0.05 s to 300 s
ANSI 27D/47 - Positive sequence undervoltage			
	15 to 60 % of $V_{LL}p$		0.05 s to 300 s
ANSI 27R - Remanent undervoltage			
	5 to 100 % of $V_{LL}p$		0.05 s to 300 s
ANSI 27S - Line-to-neutral undervoltage			
	5 to 100 % of $V_{Ln}p$		0.05 s to 300 s
ANSI 32P - Directional active overpower			
	1 to 120 % of Sn (3)		0.1 s to 300 s
ANSI 32Q/40 - Directional reactive overpower			
	5 to 120 % of Sn (3)		0.1 s to 300 s
ANSI 37 - Phase undercurrent			
	0.15 to 1 I_B		0.05 s to 300 s
ANSI 38/49T - Temperature monitoring (8 or 16 RTDs)			
Alarm and trip set points	0 to 180 °C (or 32 to 356 °F)		
ANSI 46 - Negative sequence / unbalance			
Definite time	0.1 to 5 I_B		0.1 s to 300 s
IDMT	0.1 to 0.5 I_B (Schneider Electric) 0.1 to 1 I_B (IEC, IEEE)		0.1 s to 1 s
Tripping curve	Schneider Electric		
	IEC: SIT/A, LTI/B, VIT/B, EIT/C (2)		
	IEEE: MI (D), VI (E), EI (F) (2)		
ANSI 47 - Negative sequence overvoltage			
	1 to 50 % of $V_{LL}p$		0.05 s to 300 s
ANSI 48/51LR/14 - Excessive starting time, locked rotor			
	0.5 I_B to 5 I_B	ST starting time	0.5 s to 300 s
		LT and LTS time delays	0.05 s to 300 s
ANSI 49RMS - Thermal overload		**Rate 1 and Rate 2**	
Accounting for negative sequence component		0 - 2,25 - 4,5 - 9	
Time constant	Heating	Sepam series 20 T1: 1 to 120 min	
		Sepam series 40 T1: 1 to 600 min	
	Cooling	Sepam series 20 T2: 1 to 600 min	
		Sepam series 40 T2: 5 to 600 min	
Alarm and tripping set points		50 to 300 % of rated thermal capacity	
Cold curve modification factor		0 to 100 %	
Switching of thermal settings conditions		By logic input	
		By Is set point adjustable from 0.25 to 8 I_B	
Maximum equipment temperature		60 to 200 °C (140 °F to 392 °F)	
ANSI 50/51 - Phase overcurrent			
	Tripping time delay	**Timer hold**	
Tripping curve	Definite time	DT	
	SIT, LTI, VIT, EIT, UIT (1)	DT	
	RI	DT	
	IEC: SIT/A, LTI/B, VIT/B, EIT/C	DT or IDMT	
	IEEE: MI (D), VI (E), EI (F)	DT or IDMT	
	IAC: I, VI, EI	DT or IDMT	
Is set point	0.1 to 24 I_N	Definite time	Inst ; 0.05 s to 300 s
	0.1 to 2.4 I_N	IDMT	0.1 s to 12.5 s at 10 Is
Timer hold	Definite time (DT ; timer hold)		Inst ; 0.05 s to 300 s
	IDMT (IDMT ; reset time)		0.5 s to 20 s
Confirmation (2)	None		
	By negative sequence overvoltage		
	By line-to-line undervoltage		
ANSI 50BF - Breaker failure			
Presence of current	0.2 to 2 I_N		
Operating time	0.05 s to 300 s		

(1) *Tripping as of 1.2 Is.*
(2) *Sepam series 40 only.*
(3) *Sn* = $\sqrt{3}$ .I_N.$V_{LL}p$.

Protection
Setting Ranges

Functions	Settings		Time Delays
ANSI 50N/51N or 50G/51G - Ground fault / Sensitive ground fault			
	Tripping time delay	**Timer hold**	
Tripping curve	Definite time	DT	
	SIT, LTI, VIT, EIT, UIT (1)	DT	
	RI	DT	
	IEC: SIT/A, LTI/B, VIT/B, EIT/C	DT or IDMT	
	IEEE: MI (D), VI (E), EI (F)	DT or IDMT	
	IAC: I, VI, EI	DT or IDMT	
Is r set point	0.1 to 15 Inr	Definite time	Inst ; 0.05 s to 300 s
	0.1 to 1 Inr	IDMT	0.1 s to 12.5 s at 10 Is0
Timer hold	Definite time (DT ; timer hold)		Inst ; 0.05 s to 300 s
	IDMT (IDMT ; reset time)		0.5 s to 20 s
ANSI 50V/51V - Voltage-restrained overcurrent			
	Tripping time delay	**Timer hold**	
Tripping curve	Definite time	DT	
	SIT, LTI, VIT, EIT, UIT (1)	DT	
	RI	DT	
	IEC: SIT/A, LTI/B, VIT/B, EIT/C	DT or IDMT	
	IEEE: MI (D), VI (E), EI (F)	DT or IDMT	
	IAC: I, VI, EI	DT or IDMT	
Is set point	0.5 to 24 In	Definite time	Inst ; 0.05 s to 300 s
	0.5 to 2,4 In	IDMT	0.1 s to 12.5 s at 10 Is
Timer hold	Definite time (DT ; timer hold)		Inst ; 0.05 s to 300 s
	IDMT (IDMT ; reset time)		0.5 s to 20 s
ANSI 59 - Overvoltage	**Line-to-line**	**Line-to-neutral (2)**	
	50 to 150 % of $V_{LL}p$	50 to 150 % of $V_{Ln}p$	0.05 s to 300 s
ANSI 59N - Neutral voltage displacement			
	2 to 80 % of $V_{LL}p$		0.05 s to 300 s
ANSI 66 - Starts per hour			
Starts per period	1 to 60	Period	1 to 6 hr
Consecutive starts	1 to 60	Time between starts	0 to 90 min
ANSI 67 - Directional phase overcurrent			
	Tripping time delay	**Timer hold**	
Tripping curve	Definite time	DT	
	SIT, LTI, VIT, EIT, UIT (1)	DT	
	RI	DT	
	IEC: SIT/A, LTI/B, VIT/B, EIT/C	DT or IDMT	
	IEEE: MI (D), VI (E), EI (F)	DT or IDMT	
	IAC: I, VI, EI	DT or IDMT	
Is set point	0.1 to 24 In	Definite time	Inst ; 0.05 s to 300 s
	0.1 to 2,4 In	IDMT	0.1 s to 12.5 s at 10 Is
Timer hold	Definite time (DT ; timer hold)		Inst ; 0.05 s to 300 s
	IDMT (IDMT ; reset time)		0.5 s to 20 s
Characteristic angle	30°, 45°, 60°		

(1) *Tripping as of 1.2 Is.*
(2) *Sepam series 40 only.*

Protection
Setting Ranges

Functions		Settings		Time Delays
ANSI 67N/67NC type 1 - Directional ground fault, according to Ir projection				
Characteristic angle		-45°, 0°, 15°, 30°, 45°, 60°, 90°		
Isr set point		0.1 to 15 Inr	Definite time	Inst ; 0.05 s to 300 s
Vsr set point		2 to 80 % of Un		
Memory time		T0mem time	0 ; 0.05 s to 300 s	
		Vrmem validity set point	0 ; 2 to 80 % of V_{LL}p	
ANSI 67N/67NC type 2 - Directional ground fault, according to Ir magnitude with half-plan tripping zone				
Characteristic angle		-45°, 0°, 15°, 30°, 45°, 60°, 90°		
		Tripping time delay	**Timer hold**	
Tripping curve		Definite time	DT	
		SIT, LTI, VIT, EIT, UIT(1)	DT	
		RI	DT	
		IEC: SIT/A, LTI/B, VIT/B, EIT/C	DT or IDMT	
		IEEE: MI (D), VI (E), EI (F)	DT or IDMT	
		IAC: I, VI, EI	DT or IDMT	
Isr set point		0.5 to 15 Inr	Definite time	Inst ; 0.05 s to 300 s
		0.5 to 1 Inr	IDMT	0.1 s to 12.5 s at 10 Is0
Vsr set point		2 to 80 % of V_{LL}p		
Timer hold		Definite time (DT ; timer hold)		Inst ; 0.05 s to 300 s
		IDMT (IDMT ; reset time)		0.5 s to 20 s
ANSI 67N/67NC type 3 - Directional ground fault, according to Ir magnitude with angular sector tripping zone				
Angle at start of tripping zone		0° to 359°		
Angle at end of tripping zone		0° to 359°		
Isr set point	CSH zero sequence CT (2 A rating)	0.1 A to 30 A	Definite time	Inst ; 0.05 to 300 s
	1 A CT (sensitive, Inr = 0.1 CT In)	0.05 to 15 Inr (min. 0.1 A)		
	Zero sequence CT + ACE990 (range 1)	0.05 to 15 Inr (min. 0.1 A)		
Vsr set point		Calculated Vr (sum of 3 voltages)	2 to 80 % of V_{LL}p	
		Measured Vr (external VT)	0.6 to 80 % of V_{LL}p	
ANSI 81H - Overfrequency				
Sepam series 20		50 to 53 Hz or 60 to 63 Hz		0.1 s to 300 s
Sepam series 40		50 to 55 Hz or 60 to 65 Hz		0.1 s to 300 s
ANSI 81L - Underfrequency				
Sepam series 20		45 to 50 Hz or 55 to 60 Hz		0.1 s to 300 s
Sepam series 40		40 to 50 Hz or 50 to 60 Hz		0.1 s to 300 s
ANSI 81R - Rate of change of frequency				
		0.1 to 10 Hz/s		Inst ; 0.15 s to 300 s

(1) *Tripping as of 1.2 Is.*

Control and Monitoring
Description

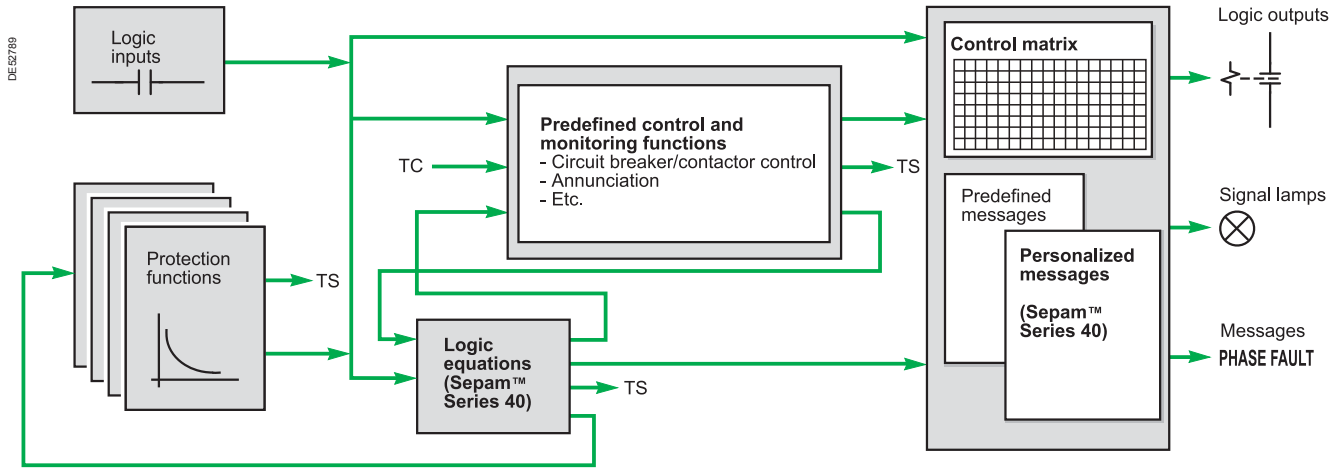
Sepam performs all the control and monitoring functions required for electrical network operation:

- the main control and monitoring functions are predefined and fit the most frequent cases of use. They are ready to use and are implemented by simple parameter setting after the necessary logic inputs / outputs are assigned.
- the predefined control and monitoring functions can be adapted for particular needs using the SFT2841 software, which offers the following customization options:
  - customization of the control matrix by changing the assignment of output relays, LEDs, and annunciation messages
  - logic equation editor, to adapt and complete the predefined control and monitoring functions (Sepam series 40 only)
  - creation of personalized messages for local annunciation (Sepam series 40 only).

Operating principle

The processing of each control and monitoring function may be broken down into 3 phases:

- acquisition of input data:
  - results of protection function processing
  - external logic data, connected to the logic inputs of an optional MES114 input / output module
  - remote control commands (TC) received via the Modbus communication link
- actual processing of the control and monitoring function
- utilization of the processing results:
  - activation of output relays to control a device
  - information sent to the facility manager:
    - by message and/or LED on the Sepam display and SFT2841 software
    - by remote indication (TS) via the Modbus communication link.



Logic inputs and outputs

The number of Sepam inputs / outputs must be adapted to fit the control and monitoring functions used. The 4 outputs included in the Sepam base unit (series 20 or series 40) may be extended by adding one MES114 module with 10 logic inputs and 4 output relays. After selecting the MES114 type required by an application, the logic inputs must be assigned to functions. The functions are chosen from a list which covers the whole range of possible uses. The functions are adapted to meet needs within the limits of the logic inputs available. The inputs may also be inverted for undervoltage type operation. A default input / output assignment is proposed for the most frequent uses.

Control and Monitoring
Description of Predefined Functions

Each Sepam contains the appropriate predefined control and monitoring functions for the chosen application.

ANSI 94/69 - Circuit Breaker/Contactor Control

Control of interrupting devices equipped with different types of closing and tripping coils:
- circuit breakers with NO or NC trip contacts
- latching contactors with NO contacts

The function processes all interrupting device closing and tripping conditions, based on:
- protection functions
- interrupting device status data
- remote control commands
- specific control functions for each application (e.g. recloser).

The function also blocks interrupting device closing, according to the operating conditions.

With Sepam series 20, it is necessary to use an MES114 module in order to have all the required logic inputs.

ANSI 86 - Latching / acknowledgement

The tripping outputs for all the protection functions and all the logic inputs can be latched individually. The latched information is saved in the event of an auxiliary power outage. (The logic outputs cannot be latched.)

All the latched data may be acknowledged:
- locally, with the reset key
- remotely via a logic input
- or via the communication link.

The Latching/acknowledgement function, when combined with the circuit breaker/contactor control function, can be used to create the ANSI 86 “Lockout relay” function.

ANSI 68 - Zone Selective Interlocking (ZSI)

This function provides:
- perfect tripping coordination with line-to-line and line-to-ground short-circuits, on all types of networks
- faster tripping of the breakers closest to the fault (solving the drawback of conventional time coordination).

Each Sepam is capable of:
- sending a blocking input when a fault is detected by the phase overcurrent and ground fault protection functions, which may or may not be directional (ANSI 50/51, 50N/51N, 67 or 67N/67NC)
- and receiving blocking inputs which block protection tripping. A control logic ensures continued operation of the protection in the event that a blocking link malfunctions or is lost.

Output relay testing

Each output relay is activated for 5 seconds, to make it simpler to check output connections and connected switchgear operation.

Local indications on the Sepam front panel.

ANSI 30 - Local annunciation

LED indication on the Sepam front panel

- 2 LEDs indicate the unit operating status:
  - green LED ON: Sepam on
  - red “key” LED: Sepam unavailable (initialization phase or detection of an internal failure)
- 9 yellow LEDs:
  - pre-assigned and identified by standard removable labels
  - the SFT2841 software tool may be used to assign LEDs and personalize labels.

Local annunciation on Sepam’s advanced UMI

Events and alarms may be indicated locally on Sepam’s advanced UMI by:

- messages on the display unit, available in 2 languages:
  - English, factory-set messages, not modifiable
  - local language, according to the version delivered (the language version is chosen when Sepam is set up)
- the lighting up of one of the 9 yellow LEDs, according to the LED assignment, which is set using SFT2841.

Alarm processing

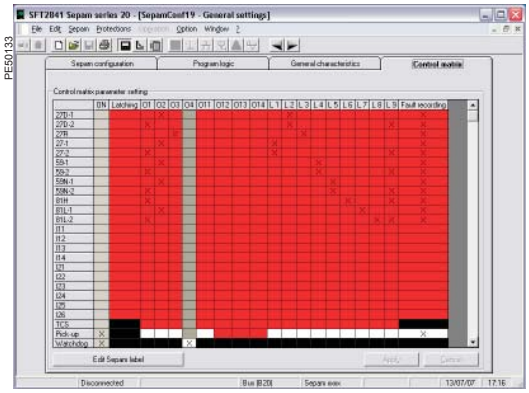
- when an alarm appears, the related message replaces the current display and the related LED goes on.

The number and type of messages depend on the type of Sepam. The messages are linked to Sepam functions and may be viewed on the front-panel display and in the SFT2841 “Alarms” screen.

- to clear the message from the display, press the clear key
- after the fault has disappeared, press the reset key: the light goes off and Sepam is reset
- the list of alarm messages remains accessible (⚠ key) and may be cleared by pressing the clear key.

Control and Monitoring
Adaptation of Predefined Functions Using the SFT2841 Software

The predefined control and monitoring functions can be adapted for particular needs using the SFT2841 software, which offers the following customization options:
- customization of the control matrix by changing the assignment of output relays, LEDs and annunciation messages
- logic equation editor, to adapt and complete the predefined control and monitoring functions (Sepam series 40 only)
- creation of personalized messages for local annunciation (Sepam series 40 only).


PE50133

SFT2841: control matrix.

Control matrix
The control matrix is a simple way to assign data from:
- protection functions
- control and monitoring functions
- logic inputs
- logic equations

to the following output data:
- output relays
- 9 LEDs on the front panel of Sepam
- messages for local annunciation
- triggering of disturbance recording.

Logic equation editor (Sepam series 40)
The logic equation editor included in the SFT2841 software can be used to:
- complete protection function processing:
  - additional interlocking
  - conditional blocking/validation of functions etc.
- adapt predefined control functions: particular circuit breaker or recloser control sequences, etc.

A logic equation is created by grouping logic input data received from:
- protection functions
- logic inputs
- remote control commands

using the Boolean operators AND, OR, XOR, NOT, and automation functions such as time delays, bi-stables and time programmer. Equation input is assisted and syntax checking is done systematically.

The result of an equation may then be:
- assigned to a logic output, LED or message via the control matrix
- transmitted by the communication link, as a new remote indication
- utilized by the circuit breaker/contactor control function to trip, close or block interrupting device closing
- used to block or reset a protection function.

Personalized alarm and operating messages (Sepam series 40)
The alarm and operating messages may be personalized using the SFT2841 software tool. The new messages are added to the list of existing messages and may be assigned via the control matrix for display:
- on the Sepam display
- in the SFT2841 “Alarms” and “Alarm History” screens.

Base Unit
Presentation

Base units are defined according to the following characteristics:
- *type of User-Machine Interface (UMI)*
- *working language*
- *type of base unit connector*
- *type of current sensor connector.*

PE50492

Sepam base unit (series 20 or series 40) with integrated advanced UMI.

PE50493

Sepam base unit (series 20 or series 40) with basic UMI.

PE50127

Customized advanced UMI.

User-Machine Interface

Two types of User-Machine Interfaces (UMI) are available for Sepam base units (series 20 or series 40):
- advanced UMI
- basic UMI.

The advanced UMI can be integrated in the base unit or installed remotely on the cubicle. Integrated and remote advanced UMIs offer the same functions.

A Sepam (series 20 or series 40) with a remote advanced UMI is made up of :
- a base unit with basic UMI, for mounting inside the LV compartment
- a remote advanced UMI (DSM303)
  - for flush mounting on the front panel of the cubicle in the location most suitable for the facility manager
  - for connection to the Sepam base unit using a prefabricated CCA77x cord.

The characteristics of the remote advanced UMI module (DSM303) are presented in the DSM303 section of Chapter 4.

Advanced UMI

Comprehensive data for facility managers

All the data required for local equipment operation may be displayed on demand:
- display of all measurement and diagnosis data in numerical format with units and/or in bar graphs
- display of operating and alarm messages, with alarm acknowledgment and Sepam resetting
- display and setting of all the Sepam parameters
- display and setting of all the parameters of each protection function
- display of Sepam and remote module versions
- output testing and logic input status display
- entry of 2 passwords to protect parameter and protection settings.

Ergonomic data presentation
- keypad keys identified by pictograms for intuitive navigation
- menu-guided access to data.
- graphical LCD screen to display any character or symbol
- excellent display quality under all lighting conditions: automatic contrast setting and backlit screen (user activated).

Basic UMI

A Sepam with basic UMI offers an economical solution suited to installations that do not require local operation (managed by a remote monitoring and control system) or to replace electromechanical or analog electronic protections units with no additional operating needs. The basic UMI includes:
- 2 signal lamps indicating Sepam operating status:
- 9 parameterizable yellow signal lamps equipped with a standard label
- reset button for clearing faults and resetting.

Working language

All the texts and messages displayed on the advanced UMI are available in 2 languages:
- English (IEC), the default working language
- and a second language, which may be
  - French
  - Spanish
  - U.S. English (ANSI)
  - another “local” language.

Please contact us regarding local language customization.

Setting and operating software

SFT2841 setting and operating software can be used for easy setting of Sepam parameters and protection functions. A PC containing the SFT2841 software is connected to the communication port on the front of the unit.

Base Unit
Presentation

Selection Guide

Base Unit	With Basic UMI	With Integrated Advanced UMI	With Remote Advanced UMI
	PE50493	PE50466	PE50467
Functions			
Local indication			
Metering and diagnosis data		■	■
Alarms and operating messages		■	■
Sepam parameter setting		■	■
Protection setting		■	■
Version of Sepam and remote modules		■	■
Status of logic inputs		■	■
Local control			
Alarm acknowledgement	■	■	■
Sepam reset	■	■	■
Output testing		■	■
Characteristics			
Screen			
Size		128 x 64 pixels	128 x 64 pixels
Automatic contrast setting		■	■
Backlit screen		■	■
Keypad			
Number of keys	1	9	9
LEDs			
Sepam operating status	2 LEDs on front	2 LEDs on front	■ base unit: 2 LEDs on front ■ remote advanced UMI: 2 LEDs on front
Indication LEDs	9 LEDs on front	9 LEDs on front	9 LEDs on remote advanced UMI
Mounting			
	Flush mounted on front of cubicle	Flush mounted on front of cubicle	■ base unit with basic UMI, mounted at the back of the compartment using the AMT840 mounting plate ■ DSM303 remote advanced UMI module ,flush mounted on the front of the cubicle and connected to the base unit with the CCA77x prefabricated cord

Base Unit
Presentation

Hardware Characteristics

Auxiliary power supply
Sepam series 20 and Sepam series 40 can be supplied by either of the following voltages:
- 24 to 250 V DC
- 110 to 240 V AC.

Four relay outputs
The 4 relay outputs O1 to O4 on the base unit must be connected to connector (A). Each output can be assigned to a predetermined function using the SFT2841 software. O1, O2 and O3 are 3 control outputs with one NO contact. O1 and O2 are used by default for the switchgear control function:
- O1: switchgear tripping
- O2: switchgear closing blocked.

O4 is an indication output with one NO contact and one NC contact.
It is used by default for the watchdog function.

Main connector (A)
A choice of 2 types of removable, screw-lockable 20-pin connectors:
- CCA620 screw-type connector
- CCA622 ring lug connector.

Phase current input connector
Current sensors connected to removable, screw-lockable connectors according to type of sensors used:
- CCA630 or CCA634 connector for 1 A or 5 A current transformers
  or
- CCA670 connector for LPCT sensors.

The presence of these connectors is monitored.

Voltage input connector
Sepam B21 and B22
Voltage sensors connected to the removable, screw-lockable CCT640 connector. The presence of the CCT640 connector is monitored.

Sepam Series 40
Voltage sensors connected to the 6-pin connector (E). A choice of 2 types of removable, screw-lockable 6-pin connectors:
- CCA626 screw-type connector
  or
- CCA627 ring lug connector.

The presence of the (E) connector is monitored.

Mounting Accessories

AMT840 mounting plate
It is used to mount a Sepam with basic UMI inside the compartment with access to connectors on the rear panel. Mounting used with remote advanced UMI module (DSM303).

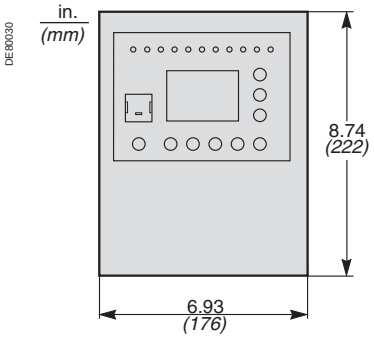
AMT852 lead sealing accessory
The AMT852 lead sealing accessory can be used to prevent unauthorized modification of the settings of Sepam series 20 and Sepam series 40 units with integrated advanced UMIs. The accessory includes:
- a lead-sealable cover plate
- the screws required to secure the cover plate to the integrated advanced UMI of the Sepam unit.

Note: *the AMT852 lead sealing accessory can secured only to the integrated advanced UMIs of Sepam series 20 and Sepam series 40 units with serial numbers higher than 0440000.*

PE50468

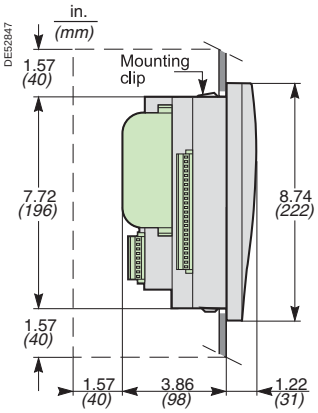
Sepam unit with integrated advanced UMI and lead sealing accessory AMT852.

Base Unit
Dimensions

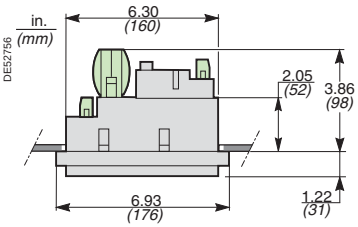


Front view of Sepam.

Dimensions



Sepam with advanced UMI and MES114, flush-mounted in front panel.



Sepam with advanced UMI and MES114, flush-mounted in front panel.

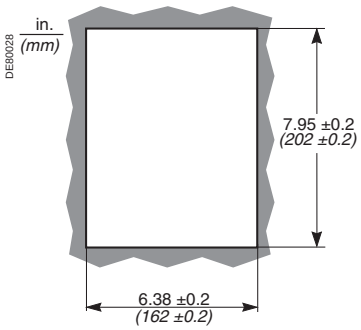
***(1)** With basic UMI: 23 mm (0.91 in).*

Clearance for Sepam assembly and wiring.

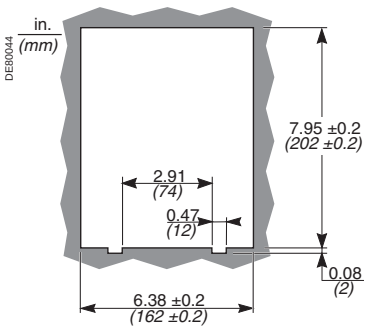
Cut-Out

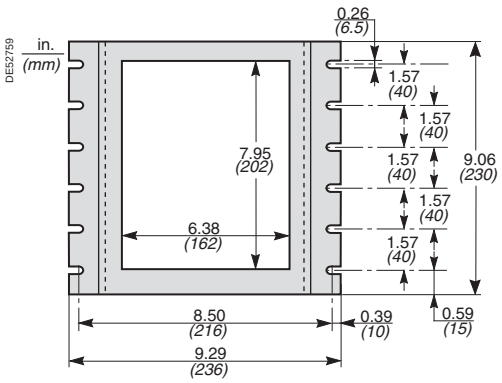
Cut-out accuracy must be complied with to ensure proper fit.

For mounting plate between 1.5 mm (0.059 in) and 3 mm (0.12 in) thick



For mounting plate 3.17 mm (0.125 inch) thick

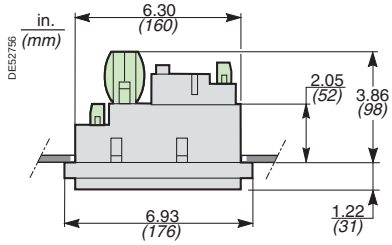




AMT840 mounting plate.

Assembly with AMT840 Mounting Plate

Used to mount Sepam with basic UMI at the back of the compartment with access to the connectors on the rear panel.
Mounting associated with the use of the remote advanced UMI (DSM303).

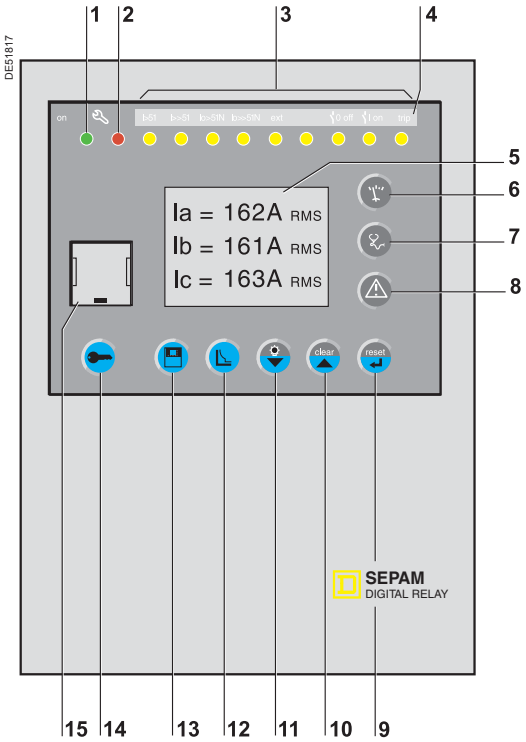


Sepam with basic UMI and MES114, mounted with AMT840 plate.
Mounting plate thickness: 2 mm (0.079 in).

Front Panel with Advanced UMI

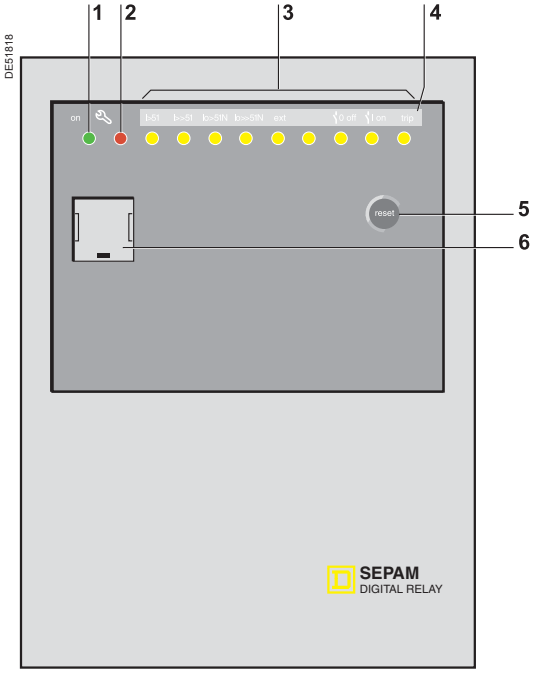
1 Green LED: Sepam on.
2 Red LED: Sepam unavailable.
3 9 yellow indication LEDs.
4 Label identifying the indication LEDs.
5 Graphical LCD screen.
6 Display of measurements.
7 Display of switchgear, network and machine diagnosis data.
8 Display of alarm messages.
9 Sepam reset (or confirm data entry).
10 Acknowledgement and clearing of alarms (or move cursor up).
11 LED test (or move cursor down).
12 Access to protection settings.
13 Access to Sepam parameter setting.
14 Entry of 2 passwords.
15 PC connection port.

The " ↵, ▲, ▼ keys **(9, 10, 11)** are used to browse through the menus and to scroll through and accept the values displayed.



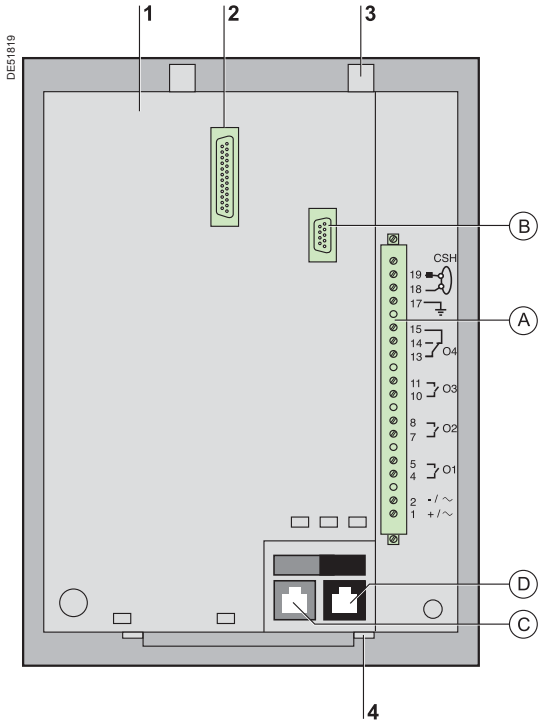
Front Panel with Basic UMI

1 Green LED: Sepam on.
2 Red LED: Sepam unavailable.
3 9 yellow indication LEDs.
4 Label identifying the indication LEDs.
5 Acknowledgement / clearing of alarms and Sepam reset.
6 PC connection port.



Base Unit
Description

Rear Panel - Sepam Series 20



1 Base unit.

(A) 20-pin connector for:
- auxiliary power supply
- 4 relay outputs
- 1 residual current input (used only with CCA630 CT connector).

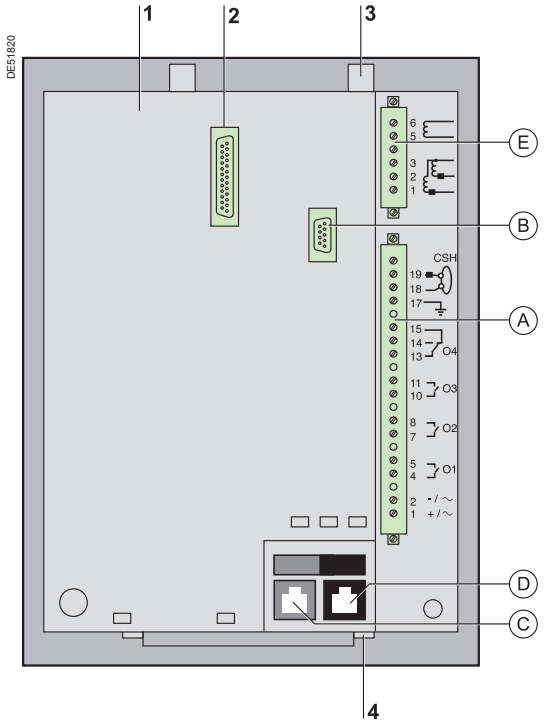
(B)
- Sepam S20, S23, T20, T23, M20: connector for 3-phase current Ia, Ib, Ic inputs and residual current
- Sepam B21 and B22: connector for 3-phase voltage Van, Vbn, Vcn inputs and 1 residual voltage Vr input.

(C) Communication port.

(D) Remote module connection port.

2 Connector for MES114 input/output module.
3 2 mounting clips.
4 2 locating nibs in flush-mounted position.

Rear Panel - Sepam Series 40



1 Base unit.

(A) 20-pin connector for:
- auxiliary power supply
- 4 relay outputs
- 1 residual current input (used only with CCA630 CT connector).

(B)
- Sepam S20, S23, T20, T23, M20: connector for 3-phase current Ia, Ib, Ic inputs and residual current
- Sepam B21 and B22: connector for 3-phase voltage Van, Vbn, Vcn inputs and 1 residual voltage Vr input.

(C) Communication port.

(D) Remote module connection port.

(E) 6-pin connector for 3-phase voltage Van, Vbn, Vcn inputs.

2 Connector for MES114 input/output module.
3 2 mounting clips.
4 2 locating nibs in flush-mounted position.

Base Unit
Technical Characteristics

Weight						
Sepam series 20		Minimum weight (base unit with basic UMI and without MES114)				1.2 kg (2.6 lb)
		Maximum weight (base unit with advanced UMI and MES114)				1.7 kg (3.7 lb)
Sepam series 40		Minimum weight (base unit with basic UMI and without MES114)				1.4 kg (3.1 lb)
		Maximum weight (base unit with advanced UMI and MES114)				1.9 kg (4.2 lb)
Analog Inputs						
Current transformer		Input impedance				< 0.02 Ω
1 A or 5 A CT (with CCA630 or CCA634)		Consumption				< 0.02 VA at 1 A
1 A to 6250 A ratings						< 0.5 VA at 5 A
		Rated thermal withstand				4 I_N
		1-second overload				100 I_N
Voltage transformer		Input impedance				> 100 kΩ
220 V to 250 kV ratings		Input voltage				100 to 230/√3 V
		Rated thermal withstand				240 V
		1-second overload				480 V
Temperature Sensor Input (MET1482 module)						
Type of sensor		Pt 100				Ni 100 / 120
Isolation from ground		None				None
Current injected in sensor		4 mA				4 mA
Maximum distance between sensor and module		1 km (0.62 mi)				
Logic Inputs		**MES114**	**MES114E**		**MES114F**	
Voltage		24 to 250 V DC	110 to 125 V DC	110 V AC	220 to 250 V DC	220 to 240 V AC
Range		19.2 to 275 V DC	88 to 150 V DC	88 to 132 V AC	176 to 275 V DC	176 to 264 V AC
Frequency		-	-	47 to 63 Hz	-	47 to 63 Hz
Typical consumption		3 mA	3 mA	3 mA	3 mA	3 mA
Typical switching threshold		14 V DC	82 V DC	58 V AC	154 V DC	120 V AC
Input limit voltage	At state 1	≥ 19 V DC	≥ 88 V DC	≥ 88 V AC	≥ 176 V DC	≥ 176 V AC
	At state 0	≤ 6 V DC	≤ 75 V DC	≤ 22 V AC	≤ 137 V DC	≤ 48 V AC
Isolation of inputs in relation to other isolated groups		Enhanced	Enhanced	Enhanced	Enhanced	Enhanced
Relays Outputs						
Control relay outputs (O1, O2, O3, O11 contacts) [2]						
Voltage	DC	24 / 48 V DC	127 V DC	220 V DC		
	AC (47.5 to 63 Hz)	-	-	-		100 to 240 V AC
Continuous current		8 A	8 A	8 A		8 A
Breaking capacity	Resistive load	8 / 4 A	0.7 A	0.3 A		
	L/R load < 20 ms	6 / 2 A	0.5 A	0.2 A		
	L/R load < 40 ms	4 / 1 A	0.2 A	0.1 A		
	Resistive load	-	-	-		8 A
	pf load > 0.3	-	-	-		5 A
Making capacity		< 15 A for 200 ms				
Isolation of outputs in relation to other isolated groups		Enhanced				
Annunciation relay output (O4, O12, O13, O14 contacts)						
Voltage	DC	24 / 48 V DC	127 V DC	220 V DC		
	AC (47.5 to 63 Hz)	-	-	-		100 to 240 V AC
Continuous current		2 A	2 A	2 A		2 A
Breaking capacity	L/R load < 20 ms	2 / 1 A	0.5 A	0.15 A		
	pf load > 0.3	-	-	-		1 A
Isolation of outputs in relation to other isolated groups		Enhanced				
Power Supply						
Voltage		24 / 250 V DC		110 / 240 V AC		
Range		-20 % +10 %		-20 % +10 % (47.5 to 63 Hz)		
Deactivated consumption [1]	Sepam series 20	< 4.5 W		< 6 VA		
	Sepam series 40	< 6 W		< 6 VA		
Maximum consumption [1]	Sepam series 20	< 8 W		< 15 VA		
	Sepam series 40	< 11 W		< 25 VA		
Inrush current	Sepam series 20, series 40	< 10 A for 10 ms, < 28 A for 100 µs		< 15 A for first half-period		
Acceptable momentary outages	Sepam series 20	10 ms		10 ms		
	Sepam series 40	10 ms		10 ms		
Analog Output (MSA141 module)						
Current		4 - 20 mA, 0 - 20 mA, 0 - 10 mA				
Load impedance		< 600 Ω (wiring included)				
Accuracy		0.50 %				

(1) *According to configuration.*
(2) *Relay outputs comply with clause 6.7 of standard C37.90 (30 A, 200 ms, 2000 operations).*

Base Unit
Environmental Characteristics

Electromagnetic Compatibility	Standard	Level / Class	Value
Emission tests			
Disturbing field emission	IEC 60255-25		
	EN 55022	A	
Conducted disturbance emission	IEC 60255-25		
	EN 55022	B	
Immunity tests – Radiated disturbances			
Immunity to radiated fields	IEC 60255-22-3		10 V/m ; 80 MHz - 1 GHz
	IEC 61000-4-3	III	10 V/m ; 80 MHz - 2 GHz
	ANSI C37.90.2 (1995)		35 V/m ; 25 MHz - 1 GHz
Electrostatic discharge	IEC 60255-22-2		8 kV air ; 6 kV contact
	ANSI C37.90.3		8 kV air ; 4 kV contact
Immunity to magnetic fields at network frequency	IEC 61000-4-8	IV	30 A/m (continuous) - 300 A/m (13 s)
Immunity tests – Conducted disturbances			
Immunity to conducted RF disturbances	IEC 60255-22-6		10 V
Fast transient bursts	IEC 60255-22-4	A or B	4 kV ; 2.5 kHz / 2 kV ; 5 kHz
	IEC 61000-4-4	IV	4 kV ; 2.5 kHz
	ANSI C37.90.1		4 kV ; 2.5 kHz
1 MHz damped oscillating wave	IEC 60255-22-1	III	2.5 kV MC ; 1 kV MD
	ANSI C37.90.1		2.5 kV MC and MD
100 kHz damped oscillating wave	IEC 61000-4-12		2.5 kV MC ; 1 kV MD
Surges	IEC 61000-4-5	III	2 kV MC ; 1 kV MD
Voltage interruptions	IEC 60255-11		Series 20: 100 %, 10 ms Series 40: 100 %, 20 ms

Mechanical Robustness	Standard	Level / Class	Value
In operation			
Vibrations	IEC 60255-21-1	2	1 Gn ; 10 Hz - 150 Hz
	IEC 60068-2-6	Fc	2 Hz - 13.2 Hz ; a = ±1 mm
Shocks	IEC 60255-21-2	2	10 Gn / 11 ms
Earthquakes	IEC 60255-21-3	2	2 Gn (horizontal axes) 1 Gn (vertical axes)
De-energized			
Vibrations	IEC 60255-21-1	2	2 Gn ; 10 Hz - 150 Hz
Shocks	IEC 60255-21-2	2	30 Gn / 11 ms
Jolts	IEC 60255-21-2	2	20 Gn / 16 ms

Climatic Withstand	Standard	Level / Class	Value
In operation			
Exposure to cold	IEC 60068-2-1	Series 20: Ab Series 40: Ad	-25 °C (-13 °F)
Exposure to dry heat	IEC 60068-2-2	Series 20: Bb Series 40: Bd	+70 °C (+158 °F)
Continuous exposure to damp heat	IEC 60068-2-3	Ca	10 days ; 93 % RH ; 40 °C (104 °F)
Temperature variation with specified variation rate	IEC 60068-2-14	Nb	–25 °C to +70 °C (-13 °F to +158 °F) 5 °C/min (41 °F/min)
Salt mist	IEC 60068-2-52	Kb/2	
Influence of corrosion/gaz test 2	IEC 60068-2-60	C	21 days ; 75 % RH ; 25 °C (-13 °F); 0.5 ppm H_2S ; 1 ppm SO_2
Influence of corrosion/gaz test 4	IEC 60068-2-60		21 days ; 75 % RH ; 25 °C ; 0.01 ppm H_2S ; 0.2 ppm SO_2 ; 0.02 ppm NO_2 ; 0.01 ppm Cl_2
In storage (3)			
Exposure to cold	IEC 60068-2-1	Ab	-25 °C (-13 °F)
Exposure to dry heat	IEC 60068-2-2	Bb	+70 °C (+158 °F)
Continuous exposure to damp heat	IEC 60068-2-3	Ca	56 days ; 93 % RH ; 40 °C (104 °F)

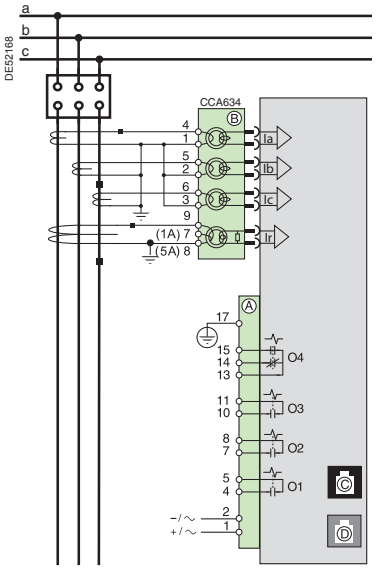
Safety	Standard	Level / Class	Value
Enclosure safety tests			
Front panel tightness	IEC 60529	IP52	Other panels closed, except for rear panel IP20
	NEMA	Type 12 with gasket supplied	
Fire withstand	IEC 60695-2-11		650 °C with glow wire (1562 °F)
Electrical safety tests			
1.2/50 µs pulse wave	IEC 60255-5		5 kV (1)
Power frequency dielectric withstand	IEC 60255-5		2 kV 1 min (2)

Certification			
CE	Harmonized standard: EN 50263	European directives: ■ 89/336/CEE Electromagnetic Compatibility (EMC) Directive □ 92/31/CEE Amendment □ 93/68/CEE Amendment ■ 73/23/CEE Low Voltage Directive □ 93/68/CEE Amendment	
UL - c UL us	UL508 - CSA C22.2 n° 14-95		File E212533
CSA	CSA C22.2 n° 14-95 / n° 94-M91 / n° 0.17-00		File 210625

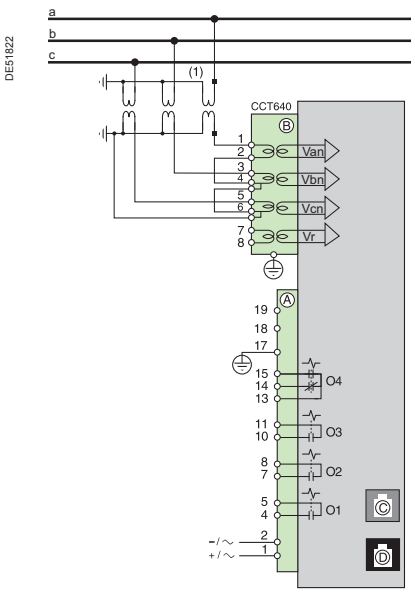
(1) *Except for communication: 3 kV in common mode and 1kV in differential mode*
(2) *Except for communication: 1 kVrms*
(3) *Sepam must be stored in its original packing.*

Base Unit
Sepam Series 20

Sepam S20, S23, T20, T23 and M20



Sepam B21 and B22



***(1)** This type of connection allows the calculation of residual voltage.*

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding
- Always use a properly rated voltage sensing device to confirm that all power is off
- Screw tight all terminals, even those not in use

Failure to follow these instructions will result in death or serious injury.

Connector	Type	Reference	Wiring
	Screw-type	CCA620	■ wiring with no fittings: □ 1 wire with max. cross-section 0.2 to 2.5 mm² (u AWG 24-12) or 2 wires with max. cross-section 0.2 to 1 mm² (u AWG 24-16) □ stripped length: 8 to 10 mm ■ wiring with fittings: □ recommended wiring with Telemecanique fittings: - DZ5CE015D for 1 x 1.5 mm² wire - DZ5CE025D for 1 x 2.5 mm² wire - AZ5DE010D for 2 x 1 mm² wires □ wire length: 8.2 mm □ stripped length: 8 mm
	6.35 mm ring lugs	CCA622	■ 6.35 mm ring or spade lugs (1/4 in) ■ maximum wire cross-section of 0.2 to 2.5 mm² (u AWG 24-12) ■ stripped length: 6 mm ■ use an appropriate tool to crimp the lugs on the wires ■ maximum of 2 ring or spade lugs per terminal ■ tightening torque: 0.7 to 1 Nm
For Sepam S20, S23, T20, T23 and M20	4 mm ring lugs	CCA630, CCA634 for connection of 1 A or 5 A CTs	■ wire cross-section of 1.5 to 6 mm² (AWG 16-10) ■ tightening torque: 1.2 Nm (13.27 lb-in)
	RJ45 plug	CCA670, for connection of 3 LPCT sensors	Integrated with LPCT sensor
For Sepam B21 and B22	Screw-type	CCT640	Same as wiring for the CCA620
	Green RJ45 plug		CCA612
	Black RJ45 plug		CCA770: L = 0.6 m (2 ft) CCA772: L = 2 m (6.6 ft) CCA774: L = 4 m (13 ft)

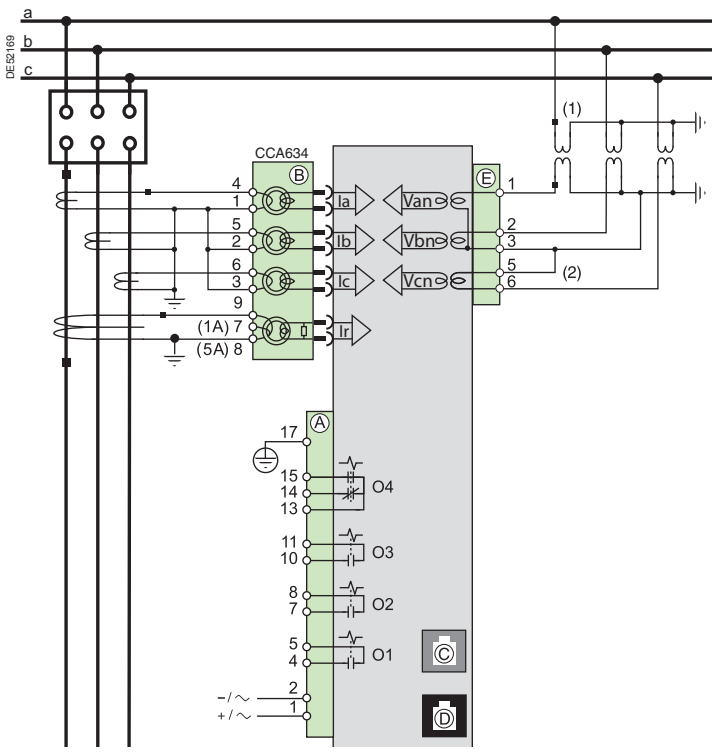
Base Unit
Sepam Series 40

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, ELECTRIC ARC OR BURNS

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding
- Always use a properly rated voltage sensing device to confirm that all power is off
- Screw tight all terminals, even those not in use

Failure to follow these instructions will result in death or serious injury.

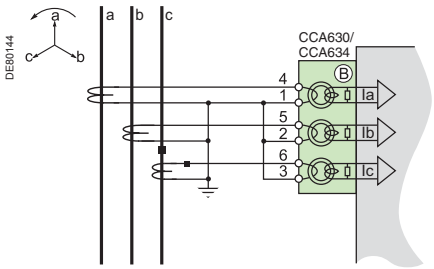


(1) *This type of connection allows the calculation of residual voltage.*
(2) *Accessory for bridging terminals 3 and 5 supplied with CCA626 and CCA627 connector.*

Connector	Type	Reference	Wiring
	Screw-type	CCA620	■ wiring with no fittings: □ 1 wire with max. cross-section 0.2 to 2.5 mm² (u AWG 24-12) or 2 wires with max. cross-section 0.2 to 1 mm² (u AWG 24-16) □ stripped length: 8 to 10 mm ■ wiring with fittings: □ recommended wiring with Telemecanique fittings: - DZ5CE015D for 1 x 1.5 mm² wire - DZ5CE025D for 1 x 2.5 mm² wire - AZ5DE010D for 2 x 1 mm² wires □ wire length: 8.2 mm □ stripped length: 8 mm
	6.35 mm ring lugs	CCA622	■ 6.35 mm ring or spade lugs (1/4 in) ■ maximum wire cross-section of 0.2 to 2.5 mm² (u AWG 24-12) ■ stripped length: 6 mm ■ use an appropriate tool to crimp the lugs on the wires ■ maximum of 2 ring or spade lugs per terminal ■ tightening torque: 0.7 to 1 Nm
	4 mm ring lugs	CCA630, CCA634, for connection of 1 A or 5 A CTs	■ wire cross-section of 1.5 to 6 mm² (AWG 16-10) ■ tightening torque: 1.2 Nm (13.27 lb-in)
	RJ45 plug	CCA670, for connection of 3 LPCT sensors	Integrated with LPCT sensor
	Green RJ45 plug		CCA612
	Black RJ45 plug		CCA770: L = 0.6 m (2 ft) CCA772: L = 2 m (6.6 ft) CCA774: L = 4 m (13 ft)
	Screw-type	CCA626	Same as wiring for the CCA620
	6.35 mm ring lugs	CCA627	Same as wiring for the CCA622

Base Unit
Other Phase Current Input Connection Schemes

Variant 1: phase current measurements by 3 x 1 A or 5 A CTs (standard connection)



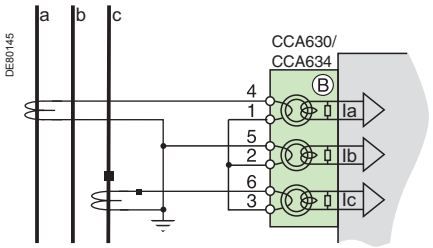
Description
Connection of 3 x 1 A or 5 A sensors to the CCA630 or CCA634 connector.

The measurement of the 3-phase currents allows the calculation of residual current.

Parameters

Sensor type	5 A CT or 1 A CT
Number of CTs	Ia, Ib, Ic
Rated current (In)	1 A to 6250 A

Variant 2: phase current measurement by 2 x 1 A or 5 A CTs



Description
Connection of 2 x 1 A or 5 A sensors to the CCA630 or CCA634 connector.

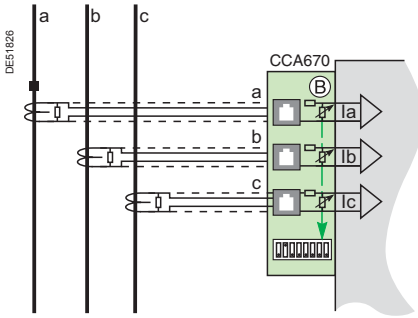
The measurement of phase currents 1 and 3 is sufficient to ensure all the phase current-based protection functions.
The phase current Ib is only assessed for metering functions, assuming that Ir = 0.

This arrangement does not allow the calculation of residual current.

Parameters

Sensor type	5 A CT or 1 A CT
Number of CTs	Ia, Ic
Rated current (In)	1 A to 6250 A

Variant 3: phase current measurement by 3 LPCT type sensors



Description
Connection of 3 Low Power Current Transducer (LPCT) type sensors to the CCA670 connector. The connection of only one or two LPCT sensors is not allowed and causes Sepam to go into fail-safe position.

The measurement of the 3-phase currents allows the calculation of residual current.

Parameters

Sensor type	LPCT
Number of CTs	Ia, Ib, Ic
Rated current (In)	25, 50, 100, 125, 133, 200, 250, 320, 400, 500, 630, 666, 1000, 1600, 2000 or 3150 A

Note: *Parameter In must be set 2 twice:*

- *Software parameter setting using the advanced UMI or the SFT2841 software tool*
- *Hardware parameter setting using microswitches on the CCA670 connector*

Base Unit
Other Residual Current Input Connection Schemes

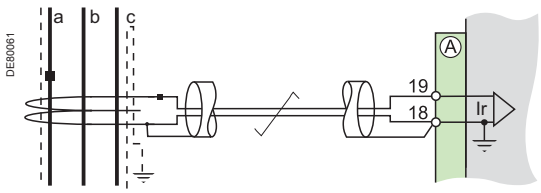
Variant 1: residual current calculation by sum of 3-phase currents

Description
Residual current is calculated by the vector sum of the 3-phase currents Ia, Ib and Ic, measured by 3 x 1 A or 5 A CTs or by 3 LPCT type sensors.
See current input connection diagrams.

Parameters

Residual current	Rated residual current	Measuring range
Sum of 3 Is	$I_{nr} = I_N$, CT primary current	0.1 to 40 I_{nr}

Variant 2: residual current measurement by CSH120 or CSH200 zero sequence CT (standard connection)

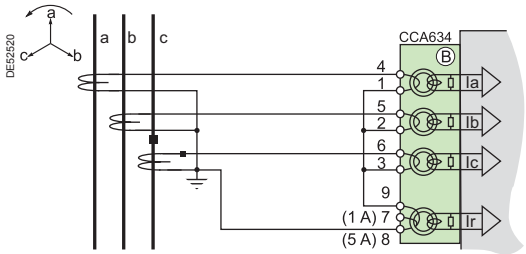


Description
Arrangement recommended for the protection of isolated or compensated neutral systems, in which very low fault currents need to be detected.

Parameters

Residual current	Rated residual current	Measuring range
2 A rating CSH	$I_{nr} = 2$ A	0.2 to 40 A
5 A rating CSH (Sepam series 40)	$I_{nr} = 5$ A	0.5 to 100 A
20 A rating CSH	$I_{nr} = 20$ A	2 to 400 A

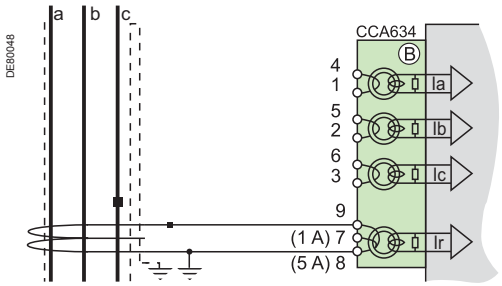
Variant 3: residual current measurement by 1 A or 5 A CTs and CCA634



Description
Residual current measurement by 1 A or 5 A CTs.
- Terminal 7: 1 A CT
- Terminal 8: 5 A CT

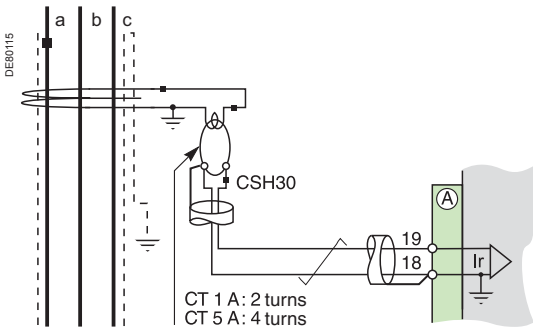
Parameters

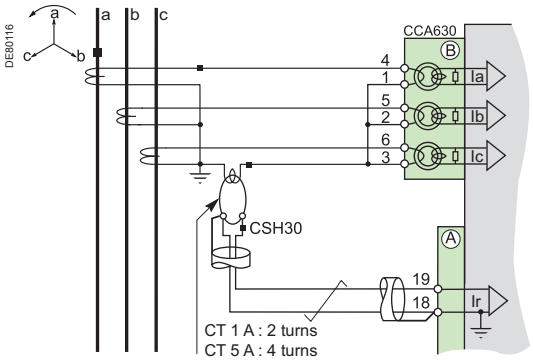
Residual current	Rated residual current	Measuring range
1 A CT	$I_{nr} = I_N$, CT primary current	0.1 to 20 I_{nr}
1 A CT sensitive	$I_{nr} = I_N/10$ (Sepam series 40)	0.1 to 20 I_{nr}
5 A CT	$I_{nr} = I_N$, CT primary current	0.1 to 20 I_{nr}
5 A CT sensitive	$I_{nr} = I_N/10$ (Sepam series 40)	0.1 to 20 I_{nr}



Base Unit
Other Residual Current Input Connection Schemes

Variant 4: residual current measurement by 1 A or 5 A CTs and CSH30 interposing ring CT





Description

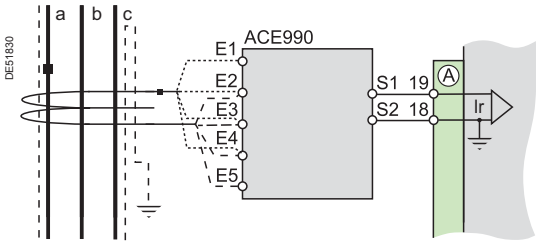
The CSH30 interposing ring CT is used to connect 1 A or 5 A CTs to Sepam to measure residual current:

- connection of CSH30 interposing ring CT to 1 A CT: make 2 turns through CSH primary
- connection of CSH30 interposing ring CT to 5 A CT: make 4 turns through CSH primary.
- for Sepam series 40, the sensitivity can be multiplied by 10 using the "sensitive" setting with $I_{Nr} = I_N/10$.

Parameters

Residual current	Rated residual current	Measuring range
1 A CT	$I_{Nr} = I_N$, CT primary current	0.1 to 20 I_{Nr}
1 A CT sensitive	$I_{Nr} = I_N/10$ (Sepam series 40)	0.1 to 20 I_{Nr}
5 A CT	$I_{Nr} = I_N$, CT primary current	0.1 to 20 I_{Nr}
5 A CT sensitive	$I_{Nr} = I_N/10$ (Sepam series 40)	0.1 to 20 I_{Nr}

Variant 5: residual current measurement by zero sequence CT with ratio of 1/n (n between 50 and 1500)



Description

The ACE990 is used as an interface between an MV zero sequence CT with a ratio of 1/n (50 < n < 1500) and the Sepam residual current input.
This arrangement allows the continued use of existing zero sequence CTs on the installation.

Parameters

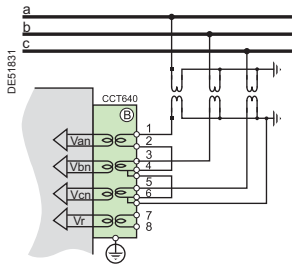
Residual current	Rated residual current	Measuring range
ACE990 - range 1 (0.00578 ⩽ k ⩽ 0.04)	$I_{Nr} = Ik.n$ (1)	0.1 to 20 I_{Nr}
ACE990 - range 2 (0.0578 ⩽ k ⩽ 0.26316)	$I_{Nr} = Ik.n$ (1)	0.1 to 20 I_{Nr}

(1) *n = number of zero sequence CT turns*
k = factor to be determined according to ACE990 wiring and setting range used by Sepam

Voltage Inputs
Sepam Series 20

The phase and residual voltage transformer secondary circuits are connected to the CCT640 connector (item Ⓑ) on Sepam series 20 type B units. The CCT640 connector contains 4 transformers which perform isolation and impedance matching of the VTs and Sepam input circuits.

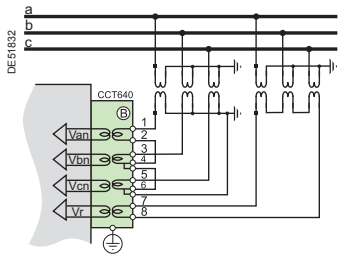
Variant 1: measurement of 3 line-to-neutral voltages (standard connection)



Parameters	
Voltages measured by VTs	Van, Vbn, Vcn
Residual voltage	Sum of 3Vs

Functions available	
Voltages measured	Van, Vbn, Vcn
Values calculated	Vab, Vbc, Vca, Vr, V1, f
Measurements available	All
Protection functions available (according to type of Sepam)	All

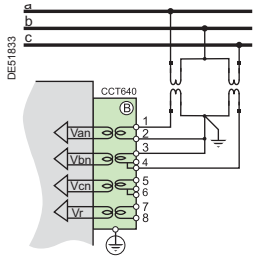
Variant 2: measurement of 3 line-to-neutral voltages and residual voltage



Parameters	
Voltages measured by VTs	Van, Vbn, Vcn
Residual voltage	External VT

Functions available	
Voltages measured	Van, Vbn, Vcn, Vr
Values calculated	Vab, Vbc, Vca, V1, f
Measurements available	All
Protection functions available (according to type of Sepam)	All

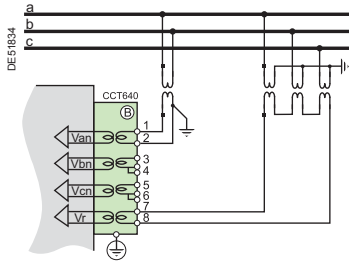
Variant 3: measurement of 2 line-to-line voltages



Parameters	
Voltages measured by VTs	Vab, Vbc
Residual voltage	None

Functions available	
Voltages measured	Van, Vbn, Vcn
Values calculated	Vca, V1, f
Measurements available	Vab, Vbc, Vca, V1, f
Protection functions available (according to type of Sepam)	All except 59N, 27S

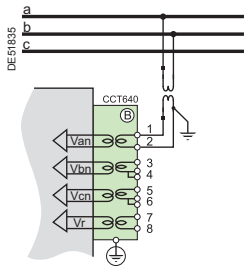
Variant 4: measurement of 1 line-to-line voltage and residual voltage



Parameters	
Voltages measured by VTs	Vab
Residual voltage	External VT

Functions available	
Voltages measured	Vab, Vr
Values calculated	f
Measurements available	Vab, Vr, f
Protection functions available (according to type of Sepam)	All except 47, 27D, 27S

Variant 5: measurement of 1 line-to-line voltage



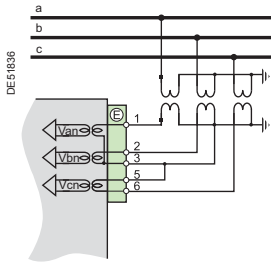
Parameters	
Voltages measured by VTs	Vab
Residual voltage	None

Functions available	
Voltages measured	Vab
Values calculated	f
Measurements available	Vab, f
Protection functions available (according to type of Sepam)	All except 47, 27D, 59N, 27S

Voltage Inputs
Sepam Series 40

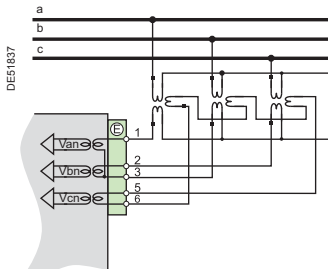
The phase and residual voltage transformer secondary circuits are connected directly to the connector marked Ⓔ. The 3 impedance matching and isolation transformers are integrated in the Sepam series 40 base unit.

Variant 1: measurement of 3 line-to-neutral voltages (standard connection)



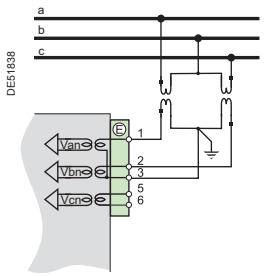
Phase voltage sensor parameter setting	3V
Residual voltage sensor parameter setting	3V sum
Voltages measured	Van, Vbn, Vcn
Values calculated	Vab, Vbc, Vca, Vr, V1, V2, f
Measurements unavailable	None
Protection functions unavailable (according to type of Sepam)	None

Variant 2: measurement of 2 line-to-line voltages and residual voltage



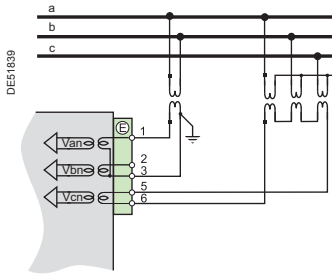
Phase voltage sensor parameter setting	Vab, Vbc
Residual voltage sensor parameter setting	External VT
Voltages measured	Vab, Vbc, Vr
Values calculated	Vca, Van, Vbn, Vcn, V1, V2, f
Measurements unavailable	None
Protection functions unavailable (according to type of Sepam)	None

Variant 3: measurement of 2 line-to-line voltages



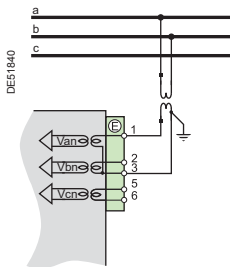
Phase voltage sensor parameter setting	Vab, Vbc
Residual voltage sensor parameter setting	None
Voltages measured	Vab, Vbc
Values calculated	Vca, V1, V2, f
Measurements unavailable	Van, Vbn, Vcn, Vr
Protection functions unavailable (according to type of Sepam)	67N/67NC, 59N

Variant 4: measurement of 1 line-to-line voltage and residual voltage



Phase voltage sensor parameter setting	Vab
Residual voltage sensor parameter setting	External VT
Voltages measured	Vab, Vr
Values calculated	f
Measurements unavailable	Vbc, Vca, Van, Vbn, Vcn, V1, V2
Protection functions unavailable (according to type of Sepam)	67, 47, 27D, 32P, 32Q/40, 27S

Variant 5: measurement of 1 line-to-line voltage



Phase voltage sensor parameter setting	Vab
Residual voltage sensor parameter setting	None
Voltages measured	Vab
Values calculated	f
Measurements unavailable	Vbc, Vca, Van, Vbn, Vcn, Vr, V1, V2
Protection functions unavailable (according to type of Sepam)	67, 47, 27D, 32P, 32Q/40, 67N/67NC, 59N, 27S

Sepam Series 80

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Selection Table

		Substation				Transformer			Motor			Generator			Bus		Cap.
Protection	**ANSI Code**	**S80**	**S81**	**S82**	**S84**	**T81**	**T82**	**T87**	**M81**	**M87**	**M88**	**G82**	**G87**	**G88**	**B80**	**B83**	**C86**
Phase overcurrent (1)	50/51	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Ground fault/Sensitive ground fault (1)	50N/51N 50G/51G	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Breaker failure	50BF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Negative sequence/unbalance	46	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Thermal overload for cables	49RMS		2	2	2												
Thermal overload for machines (1)	49RMS					2	2	2	2	2	2	2	2	2			
Thermal overload for capacitors	49RMS																2
Capacitor bank unbalance	51C																8
Restricted ground fault	64REF					2	2	2				2		2			
Two-winding transformer differential	87T							1			1			1			
Machine differential	87M									1			1				
Directional phase overcurrent (1)	67			2	2		2	2				2	2	2			
Directional ground fault (1)	67N/67NC		2	2	2	2	2	2	2	2	2	2	2	2			
Directional active overpower	32P		2	2	2	2	2	2	2	2	2	2	2	2			
Directional reactive overpower	32Q								1	1	1	1	1	1			
Directional active underpower	37P				2							2					
Phase undercurrent	37								1	1	1						
Excessive starting time, locked rotor	48/51LR								1	1	1						
Starts per hour	66								1	1	1						
Field loss (underimpedance)	40								1	1	1	1	1	1			
Pole slip	78PS								1	1	1	1	1	1			
Overspeed (2 set points) (2)	12								□	□	□	□	□	□			
Underspeed (2 set points) (2)	14								□	□	□	□	□	□			
Voltage-restrained overcurrent	50V/51V											2	2	2			
Underimpedance	21B											1	1	1			
Inadvertent energization	50/27											1	1	1			
Third harmonic undervoltage / 100 % stator ground fault	27TN/64G2 64G											2	2	2			
Overexcitation (V / Hz)	24							2				2	2	2			
Positive sequence undercurrent	27D	2	2	2	4	2	2	2	2	2	2	2	2	2	4	4	4
Remanent undervoltage	27R	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Undervoltage ($_{LL}$ or $_{Ln}$)	27	4	4	4	2	4	4	4	4	4	4	4	4	4	2	2	2
Overvoltage ($_{LL}$ or $_{Ln}$)	59	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Neutral voltage displacement	59N	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Negative sequence overvoltage	47	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Overfrequency	81H	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Underfrequency	81L	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Rate of change of frequency	81R				2												
Recloser (4 shots) (2)	79	□	□	□	□												
Thermostat / Buchholz (2)	26/63					□	□	□	□		□	□		□			
Temperature monitoring (16 RTDs) (3)	38/49T					□	□	□	□	□	□	□	□	□			□
Synchro-check (4)	25	□	□	□	□	□	□	□				□	□	□	□	□	
Control and Monitoring																	
Circuit breaker / contactor control	94/69	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Automatic transfer (AT) (2)		□	□	□	□	□	□	□				□	□	□	□	□	
Load shedding / automatic restart									■	■	■						
De-excitation												■	■	■			
Genset shutdown												■	■	■			
Capacitor step control (2)																	□
Zone sequence interlocking (2)	68	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Latching / acknowledgement	86	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Annunciation	30	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Switching of groups of settings		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Adaptation using logic equations		■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Logipam programming (Ladder language)		□	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□

The numbers indicate the number of relays available for each protection function.
■ *standard* □ *options.*
(1) *Protection functions with two groups of settings.*
(2) *According to parameter setting and optional MES120 input/output modules.*
(3) *With optional MET1482 temperature input modules.*
(4) *With optional MCS025 synchro-check module.*

Selection Table

	Substation				Transformer			Motor			Generator			Bus	
Metering	**S80**	**S81**	**S82**	**S84**	**T81**	**T82**	**T87**	**M81**	**M87**	**M88**	**G82**	**G87**	**G88**	**B80**	**B83**
Phase current Ia, Ib, Ic RMS	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Measured residual current Ir, calculated IrΣ	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Demand current Ia, Ib, Ic	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Maximum demand current Iamax, Ibmax, Icmax	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Measured residual current I'r	■	■	■	■	■	■	■	■	■	■	■	■	■	■	
Voltage Vab, Vbc, Vac, Van, Vbn, Vcn	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Residual voltage Vr	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Positive sequence voltage V1 / rotation direction	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Negative sequence voltage V2	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Frequency	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Active power P, Pa, Pb, Pc	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Reactive power Q, Qa, Qb, Qc	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Apparent power S, Sa, Sb, Sc	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Maximum demand power Pmax, Qmax	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Power factor (pf)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Calculated active and reactive energy (±Wh, ±VARh)	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Active and reactive energy by pulse counting [2] (± Wh, ± VARh)	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Phase current I'a, I'b, I'c RMS							■		■	■		■	■		
Calculated residual current I'rΣ							■		■	■		■	■		
Voltage V'ab, V'a and frequency														■	
Voltage V'ab, V'bc, V'ac, V'an, V'bn, V'cn, V'a, V'b and frequency															■
Residual voltage V'r															■
Temperature (16 RTDs) [3]					□	□	□	□	□	□	□	□	□		
Rotation speed [2]								□	□	□	□	□	□		
Neutral point voltage $V_{Ln}t$								■	■	■	■	■	■		
Network and Machine Diagnosis															
Tripping context	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Tripping current TripIa, TripIb, TripIc	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Phase fault and ground fault trip counters	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Unbalance ratio / negative sequence current I2	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Harmonic distortion (thd), current and voltage Ithd, Vthd	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Phase displacement φr, φ'r, φrΣ	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Phase displacement φa, φb, φc	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Disturbance recording	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Thermal capacity used		■	■	■	■	■	■	■	■	■	■	■	■		
Remaining operating time before overload tripping		■	■	■	■	■	■	■	■	■	■	■	■		
Waiting time after overload tripping		■	■	■	■	■	■	■	■	■	■	■	■		
Running hours counter / operating time					■	■	■	■	■	■	■	■	■		
Starting current and time								■	■	■					
Start block time								■	■	■					
Number of starts before block								■	■	■					
Unbalance ratio / negative sequence current I'2							■		■	■		■	■		
Differential current Idiffa, Idiffb, Idiffc							■		■	■		■	■		
Through current Ita, Itb, Itc							■		■	■		■	■		
Current phase displacement θ							■		■	■		■	■		
Apparent positive sequence impedance Z1		■	■	■	■	■	■	■	■	■	■	■	■	■	■
Apparent line-to-line impedances Zab, Zbc, Zac		■	■	■	■	■	■	■	■	■	■	■	■	■	■
Third harmonic voltage, neutral point or residual											■	■	■		
Difference in amplitude, frequency and phase of voltages compared for synchro-check [4]	□	□	□	□	□	□	□				□	□	□	□	□
Capacitor unbalance current and capacitance															
Switchgear Diagnosis **ANSI Code**															
CT / VT supervision 60/60FL	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Trip circuit supervision [2] 74	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Auxiliary power supply monitoring	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Cumulative breaking current	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
Number of operations, operating time, charging time, number of racking out operations [2]	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Modbus Communication, IEC 60 870-5-103, DNP3 or IEC 850															
Measurement readout [4]	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Remote indication and events time tagging [4]	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Remote control commands [4]	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Remote protection setting [4]	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□
Disturbance recording data transfer [4]	□	□	□	□	□	□	□	□	□	□	□	□	□	□	□

■ *standard* □ *options.*

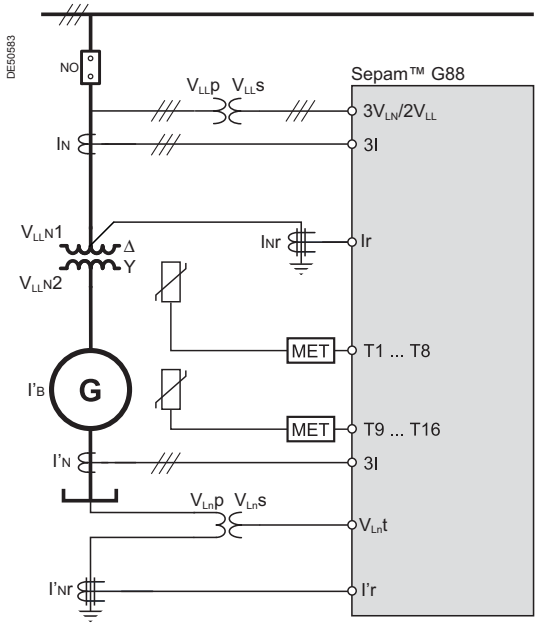
(2) *According to parameter setting and optional MES120 input/output modules.*

(3) *With optional MET1482 temperature input modules.*

(4) *With optional MCS025 synchro-check module.*

(5) *With ACE9492, ACE959, ACE937, ACE969TP, ACE969FO or ECI850 communication interface.*

Sensor Inputs



Sepam G88 sensor inputs

Sepam Series 80 has analog inputs that are connected to the measurement sensors required for applications:

- main analog inputs, available on all types of Sepam Series 80:
  - 3 phase current inputs Ia, Ib, Ic
  - 1 residual current input Ir
  - 3 phase voltage inputs Van, Vbn, Vcn
  - 1 residual voltage input Vr
- additional analog inputs, dependent on the type of Sepam:
  - 3 additional phase current inputs I'a, I'b, I'c
  - 1 additional residual current input I'r
  - 3 additional phase voltage inputs V'an, V'bn, V'cn
  - 1 additional residual voltage input V'r

The table below lists the analog inputs available according to the type of Sepam Series 80.

		S80, S81, S82, S84	T81, T82, M81, G82	T87, M87, M88, G87, G88	B80	B83	C86
Phase current inputs	Main channel	Ia, Ib, Ic	Ia, Ib, Ic	Ia, Ib, Ic	Ia, Ib, Ic	Ia, Ib, Ic	Ia, Ib, Ic
	Additional channels			I'a, I'b, I'c			
Residual current inputs	Main channel	Ir	Ir	Ir	Ir	Ir	Ir
	Additional channels	I'r	I'r	I'r	I'r		
Unbalance current inputs for capacitor steps							I'a, I'b, I'c, I'r
Phase voltage inputs	Main channel	Van, Vbn, Vcn or Vab, Vbc	Van, Vbn, Vcn or Vab, Vbc	Van, Vbn, Vcn or Vab, Vbc	Van, Vbn, Vcn or Vab, Vbc	Van, Vbn, Vcn or Vab, Vbc	Van, Vbn, Vcn or Vab, Vbc
	Additional channels				V'an or V'ab	V'an, V'bn, V'cn or V'ab, V'bc	
Residual voltage inputs	Main channel	Vr	Vr	Vr	Vr (1)	Vr	Vr
	Additional channel					V'r	
Temperature inputs (on MET1482 module)			T1 to T16	T1 to T16			T1 to T16

Note: *by extension, an additional measurement (current or voltage) is a value measured via an additional analog channel.*
(1) *Available with phase voltage Vab, Vbc.*

General Settings

The general settings define the characteristics of the measurement sensors that are connected to Sepam. They determine the performance of the metering and protection functions used. They are accessed via the SFT2841 setting software “General Characteristics”, “CT-VT Sensors” and “Particular characteristics” tabs.

General Settings		Selection	Value
I_N, I'_N	Rated phase current (sensor primary current)	2 or 3 1 A / 5 A CTs	1 A to 6250 A
		3 LPCTs	25 A to 3150 A(1)
I'_N	Unbalance current sensor rating (capacitor application)	CT 1 A / 2 A / 5 A	1 A to 30 A
I_B	Base current, according to rated power of equipment		0.2 to 1.3 I_N
I'_B	Base current on additional channels (not adjustable)	Applications with transformer	$I'_B = I_B \times V_{Ln}a/V_{Ln}b$
		Other applications	$I'_B = I_B$
I_{Nr}, I'_{Nr}	Rated residual current	Sum of 3 phase currents	See I_N(I'_N) rated phase current
		CSH120 or CSH200 zero sequence CT	2 A or 20 A rating
		1 A/5 A CT + CSH30 interposing ring CT	1 A to 6250 A
		Zero sequence CT + ACE990 (the zero sequence CT ratio 1/n must be such that $50 \leqslant n \leqslant 1500$)	According to current monitored and use of ACE990
$V_{LL}p$, $V'_{LL}p$	Rated primary line-to-line voltage ($V_{Ln}p$: rated primary line-to-neutral voltage $V_{Ln}p = V_{LL}p/\sqrt{3}$)		220 V to 250 kV
$V_{LL}s$, $V'_{LL}s$	Rated secondary line-to-line voltage	3 VTs: Van, Vbn, Vcn	90 to 230 V
		2 VTs: Vab, Vbc	90 to 120 V
		1 VT: Vab	90 to 120 V
		1 VT: Van	90 to 230 V
$V_{LL}sr$, $V'_{LL}sr$	Secondary zero sequence voltage relative to primary zero sequence voltage $V_{LL}p/\sqrt{3}$		$V_{Ln}s/3$ or $V_{Ln}s/\sqrt{3}$
$V_{Ln}p$	Neutral point voltage transformer primary voltage (generator application)		220 V to 250 kV
$V_{Ln}s$	Neutral point voltage transformer secondary voltage (generator application)		57.7 V to 133 V
f_N	Rated frequency		50 Hz or 60 Hz
	Phase rotation direction		1-2-3 oru 1-3-2
	Demand interval (for demand current and maximum demand current and power)		5, 10, 15, 30, 60 min
	Pulse-type accumulated energy meter	Increments active energy	0.1 kWh to 5 MWh
		Increments reactive energy	0.1 kVARh to 5 MVARh
P	Rated transformer power		100 kVA to 999 MVA
$V_{Ln}1$	Rated winding 1 voltage (main channels: I)		220 V to 220 kV
$V_{Ln}2$	Rated winding 2 voltage (additional channels: I')		220 V to 400 kV
I_{N1}	Rated winding 1 current (not adjustable)		$I_{N1} = P/(\sqrt{3}\ V_{Ln}1)$
I_{N2}	Rated winding 2 current (not adjustable)		$I_{N2} = P/(\sqrt{3}\ V_{Ln}2)$
	Transformer vector shift		0 to 11
ω_N	Rated speed (motor, generator)		100 to 3600 rpm
R	Number of pulses per rotation (for speed acquisition)		1 to 1800 ($\omega_N \times R/60 \leqslant 1500$)
	Zero speed set point		5 to 20 % of ω_N
	Number of capacitor steps		1 to 4
	Connection of capacitor steps		Wye / Delta
	Capacitor step ratio	Step 1	1
		Step 2	1, 2
		Step 3	1, 2, 3, 4
		Step 4	1, 2, 3, 4, 6, 8

(1) *I_N values for LPCT, in Amps: 25, 50, 100, 125, 133, 200, 250, 320, 400, 500, 630, 666, 1000, 1600, 2000, 3150.*

Metering and Diagnosis
Description

Metering

Sepam is a precision metering unit. All the metering and diagnosis data used for commissioning and required for the operation and maintenance of your equipment are available locally or remotely, expressed in the units concerned (A, V, W, etc.).

Phase Current

RMS current for each phase, factoring harmonics up to the 13th level. Different types of sensors may be used to meter phase current:

- 1 A or 5 A current transformers
- LPCT type current sensors

Residual Current

Four types of residual current values are available depending on the type of Sepam and sensors connected to it:

- two residual currents IrΣ and I'rΣ, calculated by the vector sum of the 3 phase currents
- two measured residual currents Ir and I'r.

Different types of sensors may be used to measure residual current:

- CSH120 or CSH200 specific zero sequence CT
- conventional 1 A or 5 A current transformer with CSH30 interposing ring CT
- any zero sequence CT with an ACE990 interface

Demand Current and Maximum Demand currents

Demand and maximum demand currents are calculated according to the three phase currents Ia, Ib, and Ic:

- demand current is calculated over an adjustable period of 5 to 60 minutes
- maximum demand current is the greatest demand current and indicates the current drawn by maximum loads.

Maximum demand currents can be cleared

Voltage and Frequency

The following measurements are available according to the voltage sensors connected:

- line-to-neutral voltages Van, Vbn, Vcn and V'an, V'bn, V'cn
- line-to-line voltages Vab, Vbc, Vca and V'ab, V'bc, V'ca
- residual voltage Vr, V'r or neutral point voltage V_{NT}
- positive sequence voltage V1, V'1 and negative sequence voltage V2, V'2
- frequency measured on the main and additional voltage channels.

Power

Powers are calculated according to the phase currents Ia, Ib and Ic:

- active power
- reactive power
- apparent power
- power factor (pf).

According to the sensors used, power calculations may be based on the two or three wattmeter method. The two wattmeter method is only accurate when there is no residual current and it is not applicable if the neutral is distributed. The three wattmeter method accurately calculates 3-phase and phase by phase powers in all cases, regardless of whether or not the neutral is distributed.

Maximum Demand Powers

The greatest demand active and reactive power values are calculated over the same period as the demand current. The maximum demand powers may be cleared.

Energy

- Four accumulated energies are calculated by using voltages and phase currents Ia, Ib, and Ic. They are used to measure active energy and reactive energy in both directions
- 1 to 4 additional accumulated energy meters can be used to acquire active or reactive energy pulses from external meters

Temperature

Accurate measurement of temperature inside equipment fitted with Pt100, Ni100 or Ni120 type RTDs, connected to the optional remote MET1482 module.

Rotation Speed

Rotation speed is calculated by counting the pulses transmitted by a proximity sensor at each passage of a cam driven by the rotation of the motor or generator shaft. Acquisition of pulses on a logic input.

Phasor Diagram

A phasor diagram is displayed by SFT2841 software and the mimic-based UMI to check cabling and assist in the setting and commissioning of directional and differential protection functions.

According to the connected sensors, all current and voltage information can be selected for display in vector form.

Metering and Diagnosis
Description

Network Diagnosis Assistance

Sepam provides network power quality metering functions, and all the data on network disturbances detected by Sepam. The data are recorded for analytical purposes.

Tripping Context

Storage of tripping currents and Ir, I2, Vab, Vbn, Vca, Van, Vbn, Vcn, Vr, V1, V2, F, P, Q, Idiff, It and VNt values when tripping occurs. The values for the last five trips are stored.

Tripping Current

Storage of the 3 phase currents and ground fault current at the time of the last Sepam trip command, to indicate fault current. The values are stored in the tripping contexts.

Number of Trips

2 trip counters:

- number of phase fault trips, incremented by each trip triggered by ANSI 50/51, 50V/51V and 67 protection functions
- number of ground fault trips, incremented by each trip triggered by ANSI 50N/51 and 67N/67NC protection functions.

Negative Sequence/Unbalance

Negative sequence component of phase currents Ia, Ib, and Ic (and I'a, I'b and I'c), indicating the degree of unbalance in the power supplied to the protected equipment.

Total harmonic Distortion

Two THD values calculated to assess network power quality, taking into account harmonics up to number 13:

- current THD, calculated according to Ia
- voltage THD, calculated according to Van or Vab.

Phase Displacement

- phase displacement φa, φb, φc between phase currents Ia, Ib, Ic and voltages Van, Vbn, Vcn respectively
- phase displacement φr between residual current and residual voltage.

Disturbance Recording

Recording triggered by user-set events:

- all sampled values of measured currents and voltages
- status of all logic inputs and outputs logic data: instantaneous, etc.

Recording Characteristics		
Number of recordings in COMTRADE format		Adjustable from 1 to 19
Total duration of a recording		Adjustable from 1 to 11 s
Number of samples per period		12 or 36
Duration of recording prior to occurrence of the event		Adjustable from 0 to 99 periods
Maximum Recording Capability		
Network Frequency	**12 Samples per Period**	**36 Samples per Period**
50 Hz	22 s	7 s
60 Hz	18 s	6 s

Voltage Comparison for Synchro-Check

For the synchro-check function, the MCS025 module continuously measures the amplitude, frequency and phase differences between the 2 voltages to be checked.

Out-of-Sync Context

Storage of amplitude, frequency and phase differences between the 2 voltages measured by the MCS025 module when a closing command is blocked by the synchro-check function.

Metering and Diagnosis
Description

Machine Diagnosis Assistance

Sepam assists facility managers by providing:
- data on the operation of their machines
- predictive data to optimize process management
- useful data to facilitate protection function setting and implementation

Thermal Capacity Used

Equivalent temperature buildup in the machine is calculated by the thermal overload protection function. This value is displayed as a percentage of rated thermal capacity.

Remaining Operating Time before Overload Tripping

Predictive data is calculated by the thermal overload protection function. The time is used by facility managers to optimize process management in real time by deciding to:
- interrupt according to procedures
- continue operation with blocking of thermal protection on overloaded machine.

Waiting Time after Overload Tripping

Predictive data is calculated by the thermal overload protection function. The purpose of waiting time is to avoid further tripping of thermal overload protection that is caused by premature re-energizing of insufficiently cooled down equipment.

Running Hours Counter/Operating Time

Equipment is considered to be running whenever a phase current is over 0.1 I_B. Cumulative operating time is given in hours.

Motor Starting/Overload Current and Time

A motor is considered to be starting or overloaded when a phase current is over 1.2 I_B. For each start / overload, Sepam stores:
- maximum current drawn by the motor
- starting / overload time.

The values are stored until the following start / overload.

Number of Starts before Block/Start Block Time

This indicates the number of starts still allowed by the starts per hour protection function. If the number is zero, there is only one start per hour allowed.

Differential and Through Current

Values calculated to facilitate the implementation of ANSI 87T and 87M differential protection functions.

Current Phase Displacement

Phase shift between the main phase currents and additional phase currents to facilitate implementation of ANSI 87T differential protection function.

Apparent Positive Sequence Impedance Z1

This value is calculated to facilitate implementing the underimpedance field loss protection (ANSI 40).

Apparent Line-to-line Impedances Zab, Zbc, Zac

Values calculated to facilitate the implementation of the backup underimpedance protection function (ANSI 21B).

Third Harmonic Neutral Point or Residual Voltage

Values measured to facilitate the implementation of the third harmonic undervoltage / 100 % stator ground fault protection function (ANSI 27TN/64G2).

Capacitance

Measurement, for each phase, of the total capacitance of the connected capacitor bank steps. This measurement is used to monitor the condition of the capacitors.

Capacitor Unbalance Current

Measurement of the unbalance current for each capacitor bank step. This measurement is possible when the steps are connected in a double wye arrangement.

Metering and Diagnosis
Description

Switchgear Diagnosis Assistance

Switchgear diagnosis data give facility managers information on:
- mechanical condition of breaking device
- Sepam auxiliaries and assist them for preventive and curative switchgear maintenance actions

The data are to be compared to switchgear manufacturer data.

ANSI 60/60FL - CT/VT Supervision

Used to monitor the entire metering chain:
- CT and VT sensors
- connection
- Sepam analog inputs

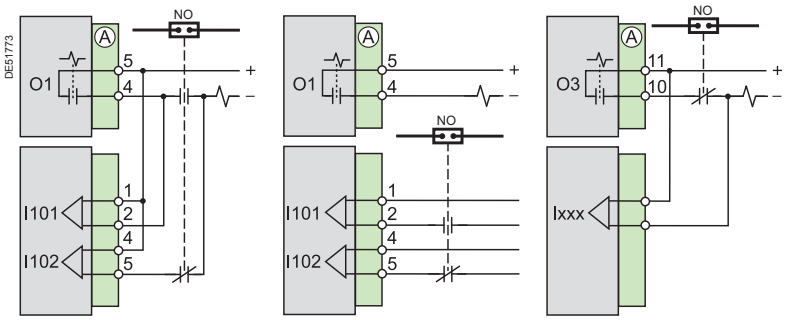
Monitoring includes:
- consistency checking of currents and voltages measured
- blown fuse indication of phase or residual voltage transformer.

If current or voltage measurement data is lost, the assigned protection functions can be blocked to avoid nuisance tripping.

ANSI 74 - Trip/Closing Circuit Supervision

To detect the health of the trip and close circuits, Sepam monitors:
- shunt trip coil connection
- closing coil connection
- matching of breaking device open/closed position contacts
- execution of breaking device open and close commands

The trip and closing circuits are only supervised when connected as shown below.



Connection for shunt trip coil monitoring.

Connection for undervoltage trip coil monitoring.

Connection for closing circuit supervision

Auxiliary Power Supply Monitoring

The voltage rating of Sepam's auxiliary supply should be set between 24 V DC and 250 V DC. If the auxiliary supply drifts, two alarms may be triggered:
- high set point alarm, adjustable from 105 % to 150 % of rated supply (maximum 275 V)
- low set point alarm, adjustable from 60 % to 95 % of rated supply (minimum 20 V).

Cumulative Breaking Current Monitoring

Six cumulative currents are proposed to assess interrupting device pole condition:
- total cumulative breaking current
- cumulative interrupting current between 0 and 2 I_N
- cumulative interrupting current between 2 I_N and 5 I_N
- cumulative interrupting current between 5 I_N and 10 I_N
- cumulative interrupting current between 10 I_N and 40 I_N
- cumulative interrupting current > 40 I_N.

Each time the interrupting device opens, the interrupting current is added to the cumulative total and to the appropriate range of cumulative interrupting current.

Cumulative interrupting current is given in $(kA)^2$.

An alarm can be generated when the total cumulative interrupting current exceeds a set point.

Number of Operations

Cumulative number of opening operations performed by the interrupting device.

Circuit Breaker Operating Time and Charging Time Number of Rackouts

Used to assess the condition of the interrupting device operating mechanism.

Metering and Diagnosis
Description

Sepam Self-Diagnosis

Sepam includes a number of self-tests carried out in the base unit and optional modules. The purpose of the self-tests is to:

- detect internal problems that may cause nuisance tripping or not tripping when required
- put Sepam in fail-safe position to avoid any unwanted operation
- alert the facility manager of the need for maintenance operations

Internal Failure

Two categories of internal failures are monitored:

- major failures: Sepam shutdown (to fail-safe position).
  The protection functions are blocked, the output relays are forced to drop out and the "Watchdog" output indicates Sepam shutdown
- minor failures: downgraded Sepam operation
  Sepam's main functions are operational and equipment protection is ensured.

Battery Monitoring

Monitoring of battery voltage to guarantee data is saved in the event of an outage. A battery with low charge generates an alarm.

Detection of Plugged Connectors

The system checks that the current or voltage sensors are plugged in. A missing connector is a major failure.

Configuration Checking

The system checks that the optional modules configured are present and working correctly.

The absence or malfunction of a remote module is considered a minor failure. The absence or failure of a logic input/output module is considered a major failure.

Metering and Diagnosis
Characteristics

Functions		Measurement range	Accuracy (1)	MSA141	Saving
Metering					
Phase current		0.02 to 40 I_N	±0.5 %	■	
Residual current	Calculated	0.005 to 40 I_N	±1 %	■	
	Measured	0.005 to 20 I_{Nr}	±1 %	■	
Demand current		0.02 to 40 I_N	±0.5 %		
Maximum demand current		0.02 to 40 I_N	±0.5 %		□
Line-to-line voltage	Main channels (V_{LL})	0.05 to 1.2 $V_{LL}p$	±0.5 %	■	
	Additional channels (V_{LL}')	0.05 to 1.2 $V_{LL}p$	±1 %		
Line-to-neutral voltage	Main channels (V_{Ln})	0.05 to 1.2 $V_{Ln}p$	±0.5 %	■	
	Additional channels (V_{Ln}')	0.05 to 1.2 $V_{Ln}p$	±1 %		
Residual voltage		0.015 to 3 $V_{Ln}p$	±1 %		
Neutral point voltage		0.015 to 3 $V_{Ln}p$	±1 %		
Positive sequence voltage		0.05 to 1.2 $V_{Ln}p$	±2 %		
Negative sequence voltage		0.05 to 1.2 $V_{Ln}p$	±2 %		
Frequency	Main channels (f)	25 to 65 Hz	±0.01 Hz	■	
	Additional channels (f')	45 to 55 Hz (fn = 50 Hz) 55 to 65 Hz (fn = 60 Hz)	±0.05 Hz		
Active power (total or per phase)		0.008 Sn to 999 MW	±1 %	■	
Reactive power (total or per phase)		0.008 Sn to 999 MVAR	±1 %	■	
Apparent power (total or per phase)		0.008 Sn to 999 MVA	±1 %	■	
Maximum demand active power		0.008 Sn to 999 MW	±1 %		□
Maximum demand reactive power		0.008 Sn to 999 MVAR	±1 %		□
Power factor		-1 to + 1 (CAP/IND)	±0.01	■	
Calculated active energy		0 to 2.1 x 10^8 MWh	±1 % ±1 digit		□ □
Calculated reactive energy		0 to 2.1 x 10^8 MVARh	±1 % ±1 digit		□ □
Temperature		-22 °F to +392 °F -30 °C to +200 °C	±1.8 °F from +68 to +384 °F ±1 °C from +20 to +140 °C	■	
Rotation speed		0 to 7200 rpm	±1 rpm		
Network Diagnosis Assistance					
Tripping context					□
Tripping current		0.02 to 40 In	±5 %		□
Number of trips		0 to 65535	-		□ □
Negative sequence / unbalance		1 to 500 % of I_B	±2 %		
Total harmonic distortion, current		0 to 100 %	±1 %		
Total harmonic distortion, voltage		0 to 100 %	±1 %		
Phase displacement φr (between Vr and Ir)		0 to 359°	±2°		
Phase displacement φa, φb, φc (between V and I)		0 to 359°	±2°		
Disturbance recording					□
Amplitude difference		0 to 1.2 V_{LL} sync1	±1 %		
Frequency difference		0 to 10 Hz	±0.5 Hz		
Phase difference		0 to 359°	±2°		
Out-of-sync context					□
Machine Operating Assistance					
Thermal capacity used		0 to 800 % (100 % for phase I = I_B)	±1 %	■	□ □
Remaining operating time before overload tripping		0 to 999 min	±1 min		
Waiting time after overload tripping		0 to 999 min	±1 min		
Running hours counter / operating time		0 to 65535 hours	±1 % or ±0.5 h		□ □
Starting current		1.2 I_B to 40 I_N	±5 %		□
Starting time		0 to 300 s	±300 ms		□
Number of starts before blocking		0 to 60			
Start block time		0 to 360 min	±1 min		
Differential current		0.015 to 40 I_N	±1 %		
Through current		0.015 to 40 I_N	±1 %		
Phase displacement θa, θb, θc (between I and I')		0 to 359°	±2°		
Apparent impedance Z1, Zab, Zbc, Zac		0 to 200 kw	±5 %		
Third harmonic neutral point voltage		0.2 to 30 % of $V_{Ln}p$	±1 %		
Third harmonic residual voltage		0.2 to 90 % of $V_{Ln}p$	±1 %		
Capacitance		0 to 30 F	±5 %		
Capacitor unbalance current		0.02 to 40 I'_N	±5 %		
Switchgear Diagnosis Assistance					
Cumulative breaking current		0 to 65535 kA²	±10 %		□ □
Auxiliary supply		24 V DC to 250 V DC	±4 V or ±10 %		□ □
Number of operations		0 to 4 x 10^9	-		□ □
Operating time		20 to 100 s	±1 ms		□ □
Charging time		1 to 20 s	±0.5 s		□ □
Number of rackouts		0 to 65535	-		□ □

■ *available on MSA141 analog output module, according to setup*
□ *saved in the event of auxiliary supply outage, even without battery*
□ *saved by battery in the event of auxiliary supply outage.*
(1) *Under reference conditions (IEC 60255-6), typical accuracy at I_N or $V_{LL}p$, pf > 0.8.*

3

Current Protection Functions

ANSI 50/51 - Phase Overcurrent

This function provides line-to-line short-circuit protection. There are two modes:

- overcurrent protection sensitive to the highest phase current measured
- machine differential protection sensitive to the highest differential phase currents obtained in self-balancing schemes

Characteristics

- two groups of settings
- instantaneous or time-delayed tripping
- definite time (DT), IDMT (choice of 16 standardized IDMT curves) or customized curve
- with or without timer hold
- tripping confirmed or unconfirmed, according to parameter setting:
  - unconfirmed tripping: standard
  - tripping confirmed by negative sequence overvoltage protection (ANSI 47, unit 1), as backup for distant

2-phase short-circuits

- tripping confirmed by undervoltage protection (ANSI 27, unit 1), as backup for line-to-line short-circuits in networks with low short-circuit power.

ANSI 50N/51N or 50G/51G - Ground Fault

Ground fault protection is based on measured or calculated residual current values:

- ANSI 50N/51N: residual current calculated or measured by 3 phase current sensors
- ANSI 50G/51G: residual current measured directly by a specific sensor

Characteristics

- two groups of settings
- definite time (DT), IDMT (choice of 17 standardized IDMT curves) or customized curve
- with or without timer hold
- second harmonic restraint to ensure stability during transformer energizing, activated by parameter setting

ANSI 50BF - Breaker Failure

If breaker fails to trip when signaled, as detected by the fault current persisting, this backup protection sends a tripping command to the upstream (radial) or adjacent (bi-directional) breaker(s).

ANSI 46 - Negative Sequence/Unbalance

This function provides protection against phase unbalance detected by measuring negative sequence current.

- sensitive protection to detect 2-phase faults at the ends of long lines
- protection of equipment against temperature build-up, caused by an unbalanced power supply, phase inversion or loss of phase, and against phase current unbalance

Characteristics

- 1 definite time (DT) curve
- 9 IDMT curves: 4 IEC curves and 3 IEEE curves, 1 ANSI curve in RI^2 and 1 specific Schneider curve

ANSI 49RMS - Thermal Overload

This is protection against thermal damage caused by overloads on:

- machines (transformers, motors or generators)
- cables
- capacitors

The thermal capacity used is calculated according to a mathematical model which takes into account:

- current RMS values
- ambient temperature
- negative sequence current, a cause of motor rotor temperature rise.

The “thermal capacity used” calculations may be used to determine predictive data for process control assistance. The protection may be blocked by a logic input when required by process control conditions.

Thermal Overload for Machines - Characteristics

- two groups of settings (e.g. for alarm / trip for two speed motor)
  - one adjustable alarm set point for each group
  - one adjustable tripping set point for each group
- adjustable initial thermal capacity used setting, to adapt protection characteristics to fit manufacturer’s thermal withstand curves
- equipment heating and cooling time constants.

The cooling time constant may be calculated automatically based on measurement of the equipment temperature by a sensor.

Thermal Overload for Cables - Characteristics

- one group of settings
- cable current carrying capacity, which determines alarm and trip set points
- cable heating and cooling time constants.

Thermal Overload for Capacitors - Characteristics

- one group of settings
- alarm current, which determines the alarm set point
- overload current, which determines the tripping set point
- hot tripping time and current setting, which determine a point on the tripping curve.

ANSI 51C - Capacitor Bank Unbalance

Detection of capacitor step internal faults by measuring the unbalance current flowing between the two neutral points of a step connected in a double wye arrangement. Four unbalance currents can be measured to protect up to 4 steps.

Characteristics

- two set points per step
- definite time (DT) curve.

Recloser

ANSI 79

Automation device used to limit down time after tripping due to transient or semi-permanent faults on overhead lines. The recloser commands automatic reclosing of the interrupting device after the time delay required to restore the insulation has elapsed. Recloser operation is easy to adapt for different operating modes by parameter setting.

Characteristics

- 1 to 4 reclosing shots, each shot has an adjustable delay before closing time
- adjustable, independent reclose time and blocking reclosing operation until delay time as expired.
- shot activation linked to instantaneous or time-delayed short-circuit protection function (ANSI 50/51, 50N/51N, 67, 67N/67NC) outputs by parameter setting
- blocking/locking out of recloser by logic input.

Synchro-Check

ANSI 25

This function checks the voltages upstream and downstream of a circuit breaker and allows closing when the differences in amplitude, frequency and phase are within authorized limits.

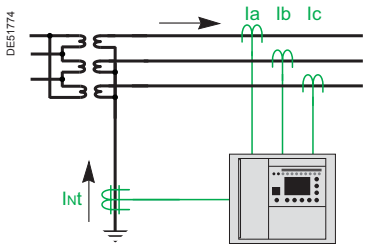
Characteristics

- adjustable and independent set points for differences in voltage, frequency and phase
- adjustable lead time to take into account the circuit-breaker closing time
- 5 possible operating modes to take no-voltage conditions into account.

Differential Protection Functions

ANSI 64REF - Restricted Ground Fault Differential

Detection of line-to-ground faults on 3-phase windings with grounded neutral, by comparison of residual current calculated from the 3 phase currents and residual current measured at the neutral point.



Characteristics

- instantaneous tripping
- percentage-based characteristic with fixed slope and adjustable low set point
- more sensitive than transformer or machine differential protection.

ANSI 87T - Transformer and Transformer- Machine Unit Differential (two windings)

Line-to-line short-circuit protection of two-winding transformers or transformer-machine units. Protection based on phase by phase comparison of the primary and secondary currents with:

- amplitude and phase correction of the currents in each winding according to the transformer vector shift and the voltage values set
- clearance of zero sequence current from the primary and secondary windings (suitable for all grounding systems).

Characteristics

- instantaneous tripping
- adjustable high set point for fast tripping for high level faults, with no restraint
- percentage-based characteristic with two adjustable slopes and adjustable low set point
- restraint based on percentage of harmonics. These restraints prevent nuisance tripping during transformer energizing, during faults outside the zone that provoke saturation of the current transformers and during operation of a transformer supplied with excessive voltage (overexcitation).
  - self-adapting neural network restraint: this restraint analyzes the percentage of the 2nd and 5th harmonics as well as differential and through currents
  - restraint based on the percentage of the 2nd harmonic per phase or total
  - restraint based on the percentage of the 5th harmonic per phase or total.

Self-adapting restraint is exclusive with respect to restraints on the percentage of the 2nd harmonic or on the percentage of the 5th harmonic.

- restraint on energization. This restraint, based on the magnetizing current of the transformer or on a logic equation or Logipam, ensures stability of transformers that have low harmonic percentages on energization
- fast restraint upon loss of sensor.

ANSI 87M - Machine Differential

Line-to-line short-circuit protection, based on phase by phase comparison of the currents on motor and generator windings.

Characteristics

- instantaneous tripping
- fixed high set point for fast tripping for high level faults, with no restraint
- percentage-based characteristic with fixed slope and adjustable low set point
- tripping restraint according to percentage characteristic activated by detection of:
  - external fault or machine starting
  - sensor saturation or disconnection
  - transformer energizing (2nd harmonic restraint)

Directional Current Protection

ANSI 67 - Directional Phase Overcurrent

This function provides line-to-line short-circuit protection, with selective tripping according to fault current direction. It comprises a phase overcurrent function associated with direction detection, and picks up if the phase overcurrent function in the chosen direction (line or bus) is activated for at least one of the three phases.

Characteristics

- two groups of settings
- instantaneous or time-delayed tripping
- choice of tripping direction
- definite time (DT), IDMT (choice of 16 standardized IDMT curves) or customized curve
- with voltage memory to make the protection insensitive to loss of polarization voltage at the time of the fault
- with or without timer hold

ANSI 67N/67NC - Directional Ground Fault

This function provides ground fault protection, with selective tripping according to fault current direction. There are two types of operation:

- type 1, projection
- type 2, according to the magnitude of the residual current phasor

ANSI 67N/67NC Type 1

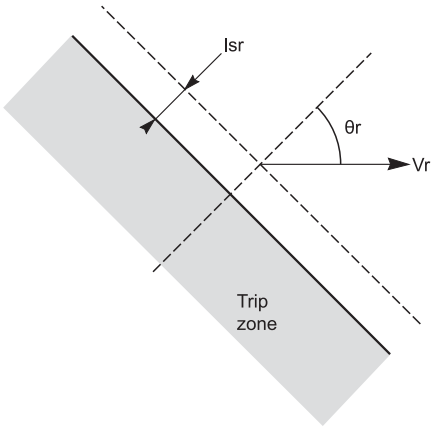
Directional ground fault protection for impedance, isolated or compensated neutral systems, based on the projection of measured residual current.

Type 1 Characteristics

There are two groups of settings

- instantaneous or time-delayed tripping
- definite time (DT) curve
- choice of tripping direction
- characteristic projection angle
- no timer hold
- with voltage memory to make the protection insensitive to recurrent faults in compensated neutral systems

DE51841



Tripping characteristic of ANSI 67N/67NC type 1 protection (characteristic angle q0 ¼ 0°).

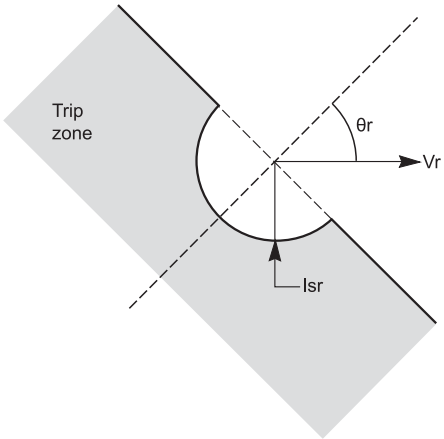
ANSI 67N/67NC Type 2

Directional overcurrent protection for impedance and solidly grounded systems, based on measured or calculated residual current. It comprises an ground fault function associated with direction detection, and picks up if the ground fault function in the chosen direction (line or bus) is activated.

Type 2 Characteristics

- two groups of settings
- instantaneous or time-delayed tripping
- definite time (DT), IDMT (choice of 16 standardized IDMT curves) or customized curve
- choice of tripping direction
- with or without timer hold

DE51842



Tripping characteristic of ANSI 67N/67NC type 2 protection (characteristic angle q0 ¼ 0°).

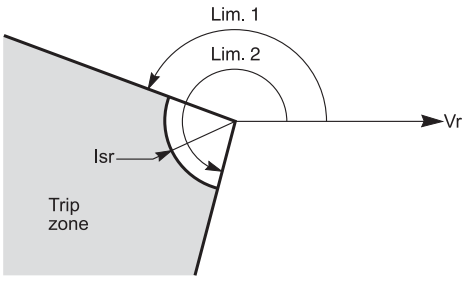
ANSI 67N/67NC Type 3

Directional overcurrent protection for distribution networks in which the neutral grounding system varies according to the operating mode, based on measured residual current. It comprises an ground fault function associated with direction detection (angular sector tripping zone defined by 2 adjustable angles), and picks up if the ground fault function in the chosen direction (line or bus) is activated.
This protection function complies with the Enel DK5600 specification.

Type 3 Characteristics

- two groups of settings
- instantaneous or time-delayed tripping
- definite time (DT) curve
- choice of tripping direction
- no timer hold

DE52064



Tripping characteristic of ANSI 67N/67NC type 3 protection.

Directional Power Protection Functions

ANSI 32P - Directional Active Overpower

Two-way protection based on calculated active power, for the following applications:

- active overpower protection to detect overloads and allow load shedding
- reverse active power protection:
  - against generators running like motors when the generators consume active power
  - against motors running like generators when the motors supply active power.

ANSI 32Q - Directional Reactive Overpower

Two-way protection based on calculated reactive power to detect field loss on synchronous machines:

- reactive overpower protection for motors which consume more reactive power with field loss
- reverse reactive overpower protection for generators which consume reactive power with field loss.

ANSI 37P - Directional Active Underpower

Two-way protection based on calculated active power
Checking of active power flows:

- to adapt the number of parallel sources to fit the network load power demand
- to create an isolated system in an installation with its own generating unit.

Machine Protection Functions

ANSI 37 - Phase Undercurrent

Protection of pumps against the consequences of a loss of priming by the detection of motor no-load operation. It is sensitive Ia below set point, remains stable during breaker tripping and may be blocked by a logic input.

ANSI 48/51LR - Locked Rotor/Excessive Starting Time

Protection of motors against overheating caused by:

- excessive motor starting time due to overloads (conveyor) or insufficient supply voltage.

The reacceleration of a motor that is not shut down, indicated by a logic input, may be considered as starting.

- locked rotor due to motor load (e.g. crusher):
  - in normal operation, after a normal start
  - directly upon starting, before the detection of excessive starting time, with detection of locked rotor by a zero speed detector connected to a logic input, or by the underspeed function.

ANSI 66 - Starts per Hour

Protection against motor overheating caused by:

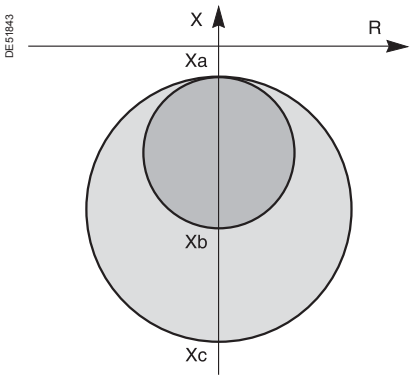
- too frequent starts: motor energizing is blocked when the maximum allowable number of starts is reached, after counting of:
  - starts per hour (or adjustable period)
  - consecutive motor hot or cold starts (reacceleration of a motor that is not shut down, indicated by a logic input, may be counted as a start)
- starts too close together in time: motor re-energizing after a shutdown is only allowed after an adjustable waiting time.

ANSI 40 - Field Loss (Underimpedance)

Protection of synchronous machines against field loss, based on the calculation of positive sequence impedance on the machine terminals or transformer terminals in the case of transformer-machine units.

Characteristics

- two circular characteristics defined by reactances Xa, Xb and Xc



2 circular tripping characteristics of ANSI 40 protection.

- tripping when the machine's positive sequence impedance enters one of the circular characteristics.
- definite (DT) time delay for each circular characteristic
- setting assistance function included in SFT2841 software to calculate the values of Xa, Xb and Xc according to the electrical characteristics of the machine (and transformer, when applicable).

3

ANSI 78PS - Pole Slip
Protection against loss of synchronism on synchronous machines, based on calculated active power. There are two types of operation:
- tripping according to the equal-area criterion, time-delayed
- tripping according to power swing (number of active power swings):
  - suitable for generators capable of withstanding high electrical and mechanical constraints
  - to be set as a number of rotations.

The two types of operation may be used independently or at the same time.

ANSI 12 - Overspeed
Detection of machine overspeed, based on the speed calculated by pulse-counting, to detect synchronous generator racing due to loss of synchronism, or for process monitoring, for example.

ANSI 14 - Underspeed
Machine speed monitoring based on the speed calculated by pulse-counting:
- detection of machine underspeed after starting, for process monitoring, for example
- zero speed data for detection of locked rotor upon starting.

ANSI 50V/51V - Voltage-Restrained Overcurrent
Line-to-line short-circuit protection, for generators. The current tripping set point is voltage-adjusted in order to be sensitive to faults close to the generator which cause voltage drops and lowers the short-circuit current.

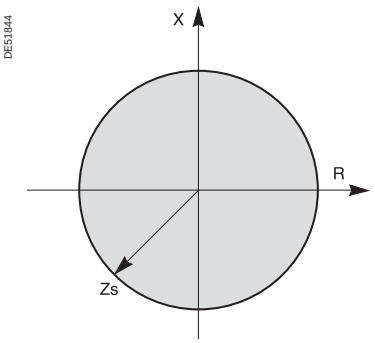
Characteristics
- instantaneous or time-delayed tripping
- definite time (DT), IDMT (choice of 16 standardized IDMT curves) or customized curve
- with or without timer hold.

ANSI 21B - Underimpedance
Line-to-line short-circuit protection, for generators, based on the calculation of apparent line-to-line impedance.

$$Zab = \frac{Vab}{Ib - Ia}$$

apparent impedance between phases a and b.

Characteristics
- circular characteristic centered at origin defined by adjustable set point Zs

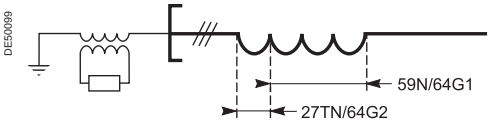


Circular tripping characteristic of ANSI 21B protection.

- time-delayed definite time (DT) tripping when one of the three apparent impedances enters the circular tripping characteristic

ANSI 50/27 - Inadvertent Energization
This function provides for checking the generator starting sequence in order to detect the inadvertent energization of generators that are shut down (a generator which is energized when shut down runs like a motor). This consists of instantaneous phase overcurrent protection confirmed by a time-delayed undervoltage protection function.

ANSI 64G - 100 % Stator Ground Fault
This function provides protection of generators with grounded neutral against line-to-ground insulation faults in stator windings. This function can be used to protect generators connected to step-up transformers. 100 % stator ground fault is a combination of two protection functions:
- ANSI 59N/64G1: neutral voltage displacement, protection of 85 % to 90 % of the stator winding, terminal end.
- ANSI 27TN/64G2: third harmonic undervoltage, protection of 10 % to 20 % of the stator winding, neutral point end.



Area of the generator's stator winding associated with the ANSI 59N and ANSI 27TN functions.

ANSI 27TN/64G2 - Third Harmonic Undervoltage
Protection of generators with grounded neutral against line-to-ground insulation faults, by the detection of a reduction of third harmonic residual voltage. Protects the 10 to 20 % of the stator winding, neutral point end, not protected by the ANSI 59N/64G1 function, neutral voltage displacement.

Characteristics
- choice of two tripping principles, according to the sensors used:
  - fixed third harmonic undervoltage set point
  - adaptive neutral and terminal third harmonic voltage comparator set point
- time-delayed definite time (DT) tripping.

ANSI 26/63 - Thermostat/Buchholz
Protection of transformers against temperature rise and internal faults via logic inputs linked to devices integrated in the transformer.

ANSI 38/49T - Temperature Monitoring
This protection detects abnormal temperature build-up by measuring the temperature inside equipment fitted with sensors:
- transformer: protection of primary and secondary windings
- motor and generator: protection of stator windings and bearings.

Characteristics
- 16 Pt100, NI100 or Ni120 type RTDs

Voltage Protection Functions

ANSI 24 - Overexcitation (V/Hz)
Protection which detects overexcitation of transformer or generator magnetic circuits by calculating the ratio between the greatest line-to-neutral or line-to-line voltage divided by the frequency.

Characteristics
- machine tie breaker to be set up
- definite time (DT) or IDMT time delays (choice of three curves)

ANSI 27D - Positive Sequence Undervoltage
Protection of motors against faulty operation due to insufficient or unbalanced network voltage, and detection of reverse rotation direction.

ANSI 27R - Remnant Undervoltage
Protection used to check that remnant voltage sustained by rotating machines has been cleared before allowing the bus supplying the machines to be re-energized, to avoid electrical and mechanical transients.

ANSI 27 - Undervoltage
Protection of motors against voltage sags or detection of abnormally low network voltage to trigger automatic load shedding or source transfer. Works with line-to-line or line-to-neutral voltage, each voltage being monitored separately.

Characteristics
- definite time (DT) curve
- IDMT curve

ANSI 59 - Overvoltage
Detection of abnormally high network voltage or checking for sufficient voltage to enable source transfer. Works with line-to-line or line-to-neutral voltage, each voltage being monitored separately.

ANSI 59N - Neutral Voltage Displacement
Detection of insulation faults by measuring residual voltage
- ANSI 59N: in isolated neutral systems
- ANSI 59N/64G1: in stator windings of generators with grounded neutral. Protects the 85 % to 90 % of the winding, terminal end, not protected by the ANSI 27TN/64G2 function, third harmonic undervoltage

Characteristics
- definite time (DT) curve
- IDMT curve

ANSI 47 - Negative Sequence Overvoltage
Protection against phase unbalance resulting from phase inversion, unbalanced supply or distant fault, detected by the measurement of negative sequence voltage. b 2 adjustable independent set points for each RTD (alarm and trip).

Frequency Protection Functions

ANSI 81H - Overfrequency
Detection of abnormally high frequency compared to the rated frequency, to monitor power supply quality.

ANSI 81L - Underfrequency
This function allows for detecting abnormally low frequency compared to the rated frequency, to monitor power supply quality. It is activated by parameter setting.

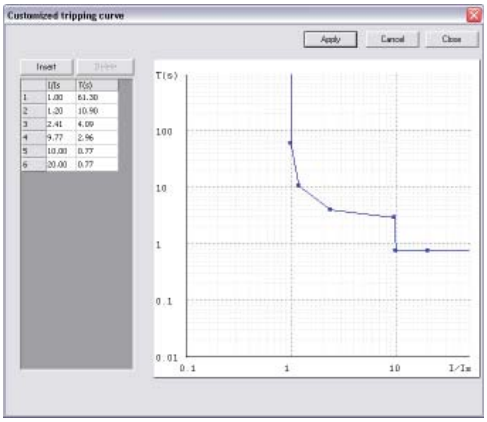
This protection can be used for overall tripping or load shedding. Protection stability is ensured if the main source is lost and there is a presence of remnant voltage. This is accomplished by a restraint in the event of a continuous frequency decrease.

ANSI 81R - Rate of Change of Frequency (df/dt)
This protection function is used for fast disconnect of a generator or load shedding control. It is based on the frequency variation calculation. It is insensitive to transient voltage disturbances and therefore more stable than a phase-shift protection function.

Disconnection
In installations with autonomous production means connected to a utility, the "rate of change of frequency" protection function is used to detect loss of the main system in view of opening the incoming circuit breaker to:
- protect the generators from a reconnection without checking synchronization
- avoid supplying loads outside the installation.

Load Shedding
The "rate of change of frequency" protection function is used for load shedding in combination with the underfrequency protection to:
- either accelerate shedding in the event of a large overload
- or block shedding following a sudden drop in frequency due to a problem that should not be solved by shedding

Protection
Trip Curves



Customized trip curve set using SFT2841 software.

Customized Trip Curve

Defined point by point using the SFT2841 setting and operating software tool, this curve can be used to solve all special cases involving protection coordination or revamping.

IDMT Trip Curves

Current IDM T Trip Curves

Multiple IDMT tripping curves are offered, to cover most applications:

- IEC curves (SIT, VIT/LTI, EIT)
- IEEE curves (MI, VI, EI)
- usual curves (UIT, RI, IAC).

IEC Curves

Equation	Curve Type	Coefficient Values		
		k	a	b
$td(I) = \frac{k}{\left(\frac{I}{Is}\right)^{\alpha} - 1} \times \frac{T}{\beta}$	Standard inverse / A	0.14	0.02	2.97
	Very inverse / B	13.5	1	1.50
	Long time inverse / B	120	1	13.33
	Extremely inverse / C	80	2	0.808
	Ultra inverse	315.2	2.5	1

RI curve

Equation: $td(I) = \frac{1}{0{,}339 - 0{,}236\left(\frac{I}{Is}\right)^{-1}} \times \frac{T}{3{,}1706}$

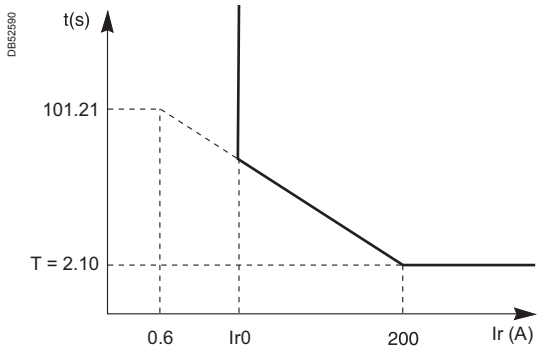
IEEE Curves

Equation	Curve Type	Coefficient Values			
		A	B	p	b
$td(I) = \left(\frac{A}{\left(\frac{I}{Is}\right)^{p} - 1} + B\right) \times \frac{T}{\beta}$	Moderately inverse	0.010	0.023	0.02	0.241
	Very inverse	3.922	0.098	2	0.138
	Extremely inverse	5.64	0.0243	2	0.081

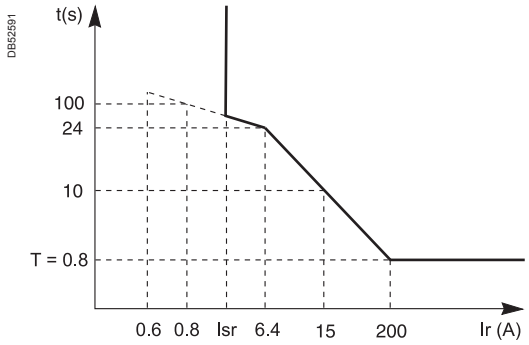
IEEE Curves

Equation	Curve Type	Coefficient Values					
		A	B	C	D	E	b
$td(I) = \left(A + \frac{B}{\left(\frac{I}{Is} - C\right)} + \frac{D}{\left(\frac{I}{Is} - C\right)^{2}} + \frac{E}{\left(\frac{I}{Is} - C\right)^{3}}\right) x \frac{T}{\beta}$	Inverse	0.208	0.863	0.800	-0.418	0.195	0.297
	Very inverse	0.090	0.795	0.100	-1.288	7.958	0.165
	Extremely inverse	0.004	0.638	0.620	1.787	0.246	0.092

Protection
Trip Curves



EPATR-C Standard curve (logarithmic scale).



EPATR-B Standard curve (logarithmic scale).

Equation for EPATRB, EPATRC

EPATRB

For 0,6 A ≤ Ir ≤ 6,4 A

$$td(I0) = \frac{85,386}{I0^{0,975}} \times \frac{T}{0,8}$$

For 6,4 A ≤ Ir ≤ 200,0 A

$$td(I0) = \frac{140,213}{I0^{0,975}} \times \frac{T}{0,8}$$

For Ir > 200,0 A

td (Ir) = T

EPATRC

For 0,6 A ≤ Ir ≤ 200,0 A

$$td(I0) = 72 \times I0^{-2,3} \times \frac{T}{2,10}$$

For Ir > 200,0 A

td (Ir) = T

Voltage IDMT Trip Curves

Equation for ANSI 27 - Undervoltage	Equation for ANSI 59N - Neutral Voltage Displacement
$td(I) = \frac{T}{1 - \left(\frac{V}{Vs}\right)}$	$td(I) = \frac{T}{\left(\frac{V}{Vs}\right) - 1}$

Voltage/Frequency Ratio IDMT Trip Curves

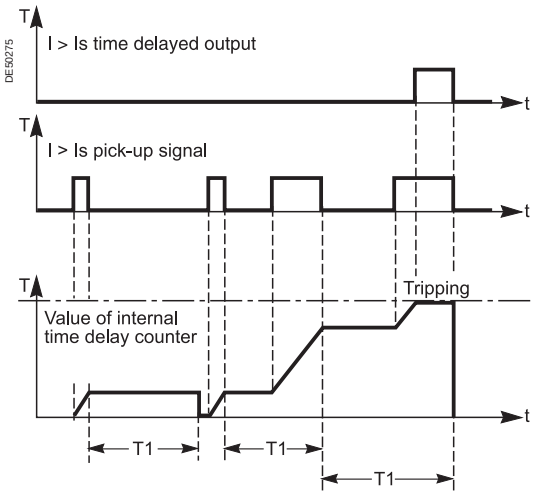
Equation for ANSI 27 - Undervoltage

With G = V_{Ln}/f or V_{LL}/f

$$td(G) = \frac{1}{\left(\frac{G}{Gs} - 1\right)^{p}} \times T$$

Curve Type	P
A	0.5
B	1
C	2

Protection
Main Characteristics



Detection of restriking faults with adjustable timer hold.

Setting IDMT Trip Curves, Time Delay, or TMS Factor

The time delays of current IDMT tripping curves (except for customized and RI curves) may be set as follows:
- time T, operating time at 10 x Is
- TMS factor, factor shown as T/b in the equations on the left

Timer Hold

The adjustable timer hold T1 is used for:
- detection of restriking faults (DT curve)
- coordination with electromechanical relays (IDMT curve).

Timer hold may be blocked, if necessary.

Two Groups of Settings

Line-to-line and Line-to-Ground Short-Circuit Protection

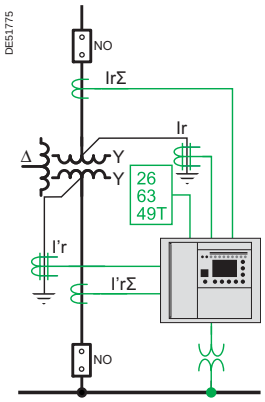
Each unit has two groups of settings, A and B, to adapt the settings to suit the network configuration. The active group of settings (A or B) is set by a logic input or the communication link.

Example: normal / backup mode network
- group A for network protection in normal mode, when the network is supplied by the utility
- group B for network protection in backup mode, when the network is supplied by a backup generator

Thermal Overload for Machines

Each unit has two groups of settings to protect equipment that has two operating modes.

Examples:
- transformers: switching of groups of settings by logic input, according to transformer ventilation operating mode, natural or forced ventilation (ONAN or ONAF)
- motors: switching of groups of settings according to current set point, to take into account the thermal withstand of motors with locked rotors



Measurement origin: example.

Measurement Origin

The measurement origin needs to be indicated for each unit of the protection functions that may use measurements of different origins. The setting links a measurement to a protection unit and allows the protection units to be distributed optimally among the measurements available according to the sensors connected to the analog inputs.

Example: distributing ANSI 50N/51N function units for transformer ground fault protection:
- two units linked to measured Ir for transformer primary protection
- two units linked to measured I'r for transformer secondary protection
- two units linked to IrΣ for protection upstream of the transformer
- two units linked to I'rΣ for protection downstream of the transformer

Summary Table

Characteristics	Protection Functions
2 groups of settings A or B	50/51, 50N/51N, 67, 67N/67NC
2 groups of settings, operating modes 1 and 2	49RMS Machine
IEC IDMT curves	50/51, 50N/51N, 50V/51V, 67, 67N/67NC type 2, 46
IEEE IDMT curves	50/51, 50N/51N, 50V/51V, 67, 67N/67NC type 2, 46
Usual IDMT curves	50/51, 50N/51N, 50V/51V, 67, 67N/67NC type 2
EPATR curves	50N/51N
Voltage IDMT curves	27, 59N, 24
Customized curve	50/51, 50N/51N, 50V/51V, 67, 67N/67NC type 2
Timer hold	50/51, 50N/51N, 50V/51V, 67, 67N/67NC type 2

Protection
Setting Ranges

Functions	Settings		Time Delays
ANSI 12 - Overspeed			
	100 to 160 % of ωn		1 to 300 s
ANSI 14 - Underspeed			
	10 to 100 % of ωn		1 to 300 s
ANSI 21B - Underimpedance			
Impedance Zs	0.05 to 2.00 V_{Ln}/I_B		
ANSI 24 - Overexcitation (V/Hz)			
Tripping curve	Definite time		
	IDMT type A, B or C		
Gs set point	1.03 to 2 pu	Definite time	0.1 to 20000 s
		IDMT	0.1 to 1250 s
ANSI 25 - Synchro-Check			
Measured voltages	Line-to-line	Line-to-neutral	
Rated Primary Line-to-line Voltage			
V_{LL}p sync1 (V_{Ln}p sync1 = V_{LL}p sync1/$\sqrt{3}$)	220 V to 250 kV	220 V to 250 kV	
V_{LL}p sync2 (V_{Ln}p sync2 = V_{LL}p sync2/$\sqrt{3}$)	220 V to 250 kV	220 V to 250 kV	
Rated Secondary Line-to-line Voltage			
V_{Ln}s sync1	90 V to 120 V	90 V to 230 V	
V_{Ln}s sync2	90 V to 120 V	90 V to 230 V	
Synchro-Check Setpoints			
dUs set point	3 % to 30 % of V_{LL}p sync1	3 % to 30 % of V_{Ln}p sync1	
dfs set point	0.05 to 0.5 Hz	0,05 to 0,5 Hz	
dPhi set point	5 to 80°	5 to 80°	
V_{LL}s high set point	70 % to 110 % V_{LL}p sync1	70 % to 110 % V_{Ln}p sync1	
V_{LL}s low set point	10 % to 70 % V_{LL}p sync1	10 % to 70 % V_{Ln}p sync1	
Other Settings			
Lead time	0 to 0.5 s	0 to 0.5 s	
Operating modes: no-voltage conditions for which a tie breaker is allowed	Dead1 AND Live2	Dead1 AND Live2	
	Live1 AND Dead2	Live1 AND Dead2	
	Dead1 XOR Dead2	Dead1 XOR Dead2	
	Dead1 OR Dead2	Dead1 OR Dead2	
	Dead1 AND Dead2	Dead1 AND Dead2	
ANSI 27 - Undervoltage ($_{LL}$) or ($_{Ln}$)			
Trip curve	Definite time		
	IDMT		
Set point	5 to 100 % of V_{LL}p		0.05 to 300 s
Measurement origin	Main channels (V_{LL}) or additional channels (V_{LL}')		
ANSI 27D - Positive Sequence Undervoltage			
Set point and time delay	15 to 60 % of V_{LL}p		0.05 to 300 s
Measurement origin	Main channels (V_{LL}) or additional channels (V_{LL}')		
ANSI 27R - Remnant Undervoltage			
Set point and time delay	5 to 100 % of V_{LL}p		0.05 to 300 s
Measurement origin	Main channels (V_{LL}) or additional channels (V_{LL}')		
ANSI 27TN/64G2 - Third Harmonic Undervoltage			
Vs set point (fixed)	0.2 to 20 % of V_{Ln}p		0.05 to 300 s
K set point (adaptive)	0.1 to 0.2		0.05 to 300 s
Positive sequence undervoltage	50 to 100 % of V_{LL}p		
Minimum apparent power	1 to 90 % of Sb (Sb = 3.V_{LL} • I_B)		
ANSI 32P - Directional Active Overpower			
	1 to 120 % of Sn (1)		0.1 s to 300 s
ANSI 32Q - Directional Reactive Overpower			
	5 to 120 % of Sn (1)		0.1 s to 300 s
ANSI 37 - Phase Undercurrent			
	0.05 to 1 I_B		0.05 to 300 s
ANSI 37P - Directional Active Underpower			
	5 to 100 % of Sn (1)		0.1 s to 300 s
ANSI 38/49T - Temperature Monitoring			
Alarm set point TS1	32 °F to 356 °F or 0 °C to 180 °C		
Trip set point TS2	32 °F to 356 °F or 0 °C to 180 °C		
ANSI 40 - Field Loss (underimpedance)			
Common point: Xa	0.02 V_{Ln}/I_B to 0.2 V_{Ln}/I_B + 187.5 kW		
Circle 1: Xb	0.2 V_{Ln}/I_B to 1.4 V_{Ln}/I_B + 187.5 kW		0.05 to 300 s
Circle 2: Xc	0.6 V_{Ln}/I_B to 3 V_{Ln}/I_B + 187.5 kW		0.1 s to 300 s

(1) Sn = $\sqrt{3}$ .I_N.V_{LL}p.

Protection
Setting Ranges

Functions	Settings		Time Delays	
ANSI 46 - Negative Sequence/Unbalance				
Tripping curve	Definite time			
	Schneider Electric			
	IEC: SIT/A, LTI/B, VIT/B, EIT/C			
	IEEE: MI (D), VI (E), EI (F)			
	RI² (setting constant from 1 to 100)			
Is set point	0.1 to 5 I_B	Definite time	0.1 to 300 s	
	0.1 to 5 I_B (Schneider Electric)	IDMT	0.1 to 1s	
	0.1 to 1 I_B (IEC, IEEE)			
	0.03 to 0.2 I_B (RI²)			
Measurement origin	Main channels (I) or additional channels (I')			
ANSI 47 - Negative Sequence Overvoltage				
Set point and time delay	1 to 50 % of $V_{LL}p$		0.05 to 300 s	
Measurement origin	Main channels (I) or additional channels (I')			
ANSI 48/51LR -Locked Rotor/Excessive Starting Time				
Is set point	0.5 I_B to 5 I_B	ST starting time	0.5 to 300 s	
		LT and LTS time delays	0.05 to 300 s	
ANSI 49RMS - Thermal Overload for Cables				
Admissible current	1 to 1.73 I_B			
Time constant T1	1 to 600 min			
ANSI 49RMS - Thermal Overload for Capacitors				
Alarm current		1.05 to 1.70 I_B		
Trip current		1.05 to 1.70 I_B		
Positioning of the hot tripping curve	Current setting	1.02 x trip current to 2 I_B		
	Time setting	1 to 2000 minutes (variable range depending on the trip current and current setting)		
ANSI 49RMS - Thermal Overload for Machines			**Mode 1**	**Mode 2**
Accounting for negative sequence component		0 - 2.25 - 4.5 - 9		
Time constant	Heating		T1: 1 to 600 min	T1: 1 to 600 min
	Cooling		T2: 5 to 600 min	T2: 5 to 600 min
Alarm and tripping set points (Es1 and Es2)		0 to 300 % of rated thermal capacity		
Initial thermal capacity used (Es0)		0 to 100 %		
Switching of thermal settings condition		by logic input		
		by Is set point adjustable from 0.25 to 8 I_B		
Maximum equipment temperature		140 °F to 392 °F (60 to 200 °C)		
Measurement origin	Main channels (I) or additional channels (I')			
ANSI 50BF - Breaker Failure				
Presence of current	0.2 to 2 I_N			
Operating time	0.05 s to 3 s			
ANSI 50/27 - Inadvertent Energization				
Is set point	0.05 to 4 I_N			
Vs set point	10 to 100 % $V_{LL}p$		T1: 0 to 10 s	
			T2: 0 to 10 s	
ANSI 50/51 - Phase Overcurrent				
	Tripping Time Delay	**Timer Hold**		
Trip curve	Definite time	DT		
	SIT, LTI, VIT, EIT, UIT (1)	DT		
	RI	DT		
	IEC: SIT/A, LTI/B, VIT/B, EIT/C	DT or IDMT		
	IEEE: MI (D), VI (E), EI (F)	DT or IDMT		
	IA : I, VI, EI	DT or IDMT		
	Customized	DT		
Is set point	0.05 to 24 I_N	Definite time	Inst; 0.05 s to 300 s	
	0.05 to 2.4 I_N	IDMT	0.1 s to 12.5 s at 10 Is	
Timer hold	Definite time (DT; timer hold)		Inst; 0.05 s to 300 s	
	IDMT (IDMT; reset time)		0.5 s to 20 s	
Measurement origin	Main channels (I) or additional channels (I')			
Confirmation	None			
	By negative sequence overvoltage			
	By line-to-line undervoltage			

(1) *Tripping as of 1.2 Is.*

Protection
Setting Ranges

Functions	Settings		Time Delays
ANSI 50N/51N or 50G/51G - Ground Fault			
	Tripping Time Delay	**Timer Hold**	
Trip curve	Definite time	DT	
	SIT, LTI, VIT, EIT, UIT (1)	DT	
	RI	DT	
	IEC: SIT/A, LTI/B, VIT/B, EIT/C	DT or IDMT	
	IEEE: MI (D), VI (E), EI (F)	DT or IDMT	
	IAC: I, VI, EI	DT or IDMT	
	EPATR-B, EPATR-C	DT	
	Customized	DT	
	0.6 to 5 A	EPATR-B	0.5 to 1 s
	0.6 to 5 A	EPATR-C	0.1 to 3 s
Isr set point	0.01 to 15 I_{Nr} (min. 0.1 A)	Definite time	Inst; 0.05 s to 300 s
	0.01 to 1 I_{Nr} (min. 0.1 A)	IDMT	0.1 s to 12.5 s at 10 Is0
Timer hold	Definite time (DT; timer hold)		Inst; 0.05 s to 300 s
	IDMT (IDMT; reset time)		0.5 s to 20 s
Measurement origin	Ir input, I'r input, sum of phase currents IrΣ or sum of phase currents I'rΣ		
ANSI 50V/51V - Voltage-Restrained Overcurrent			
	Tripping Time Delay	**Timer Hold**	
Tripping curve	Definite time	DT	
	SIT, LTI, VIT, EIT, UIT (1)	DT	
	RI	DT	
	IEC : SIT/A, LTI/B, VIT/B, EIT/C	DT or IDMT	
	IEEE : MI (D), VI (E), EI (F)	DT or IDMT	
	IAC : I, VI, EI	DT or IDMT	
	Customized	DT	
Is set point	0.5 to 24 I_N	Definite time	Inst; 0.05 s to 300 s
	0.5 to 2.4 I_N	IDMT	0.1 s to 12.5 s at 10 Isr
Timer hold	Definite time (DT; timer hold)		Inst; 0.05 s to 300 s
	IDMT (IDMT; reset time)		0.5 s to 20 s
Measurement origin	Main channels (I) or additional channels (I')		
ANSI 51C - Capacitor Bank Unbalance			
Is set point	0.05 A to 2 I'_N	Definite time	0.1 to 300 s
ANSI 59 - Overvoltage (LL) or (LN)			
Set point and time delay	50 to 150 % of $V_{LL}p$ or $V_{Ln}p$		0.05 to 300 s
Measurement origin	Main channels (V_{LL}) or additional channels (V_{LL}')		
ANSI 59N - Neutral Voltage Displacement			
Tripping curve	Definite time		
	IDMT		
Set point	2 to 80 % of $V_{LL}p$	Definite time	0.05 to 300 s
	2 to 10 % of $V_{LL}p$	IDMT	0.1 to 100 s
Measurement origin	Main channels (V_{LL}), additional channels (V_{LL}') or neutral-point voltage $V_{Ln}t$		
ANSI 64REF - Restricted Ground Fault Differential			
Isr set point	0.05 to 0.8 I_N ($I_N \geq 20$ A)		
	0.1 to 0.8 I_N ($I_N < 20$ A)		
Measurement origin	Main channels (I, Ir) or additional channels (I', I'r)		
ANSI 66 - Starts per Hour			
Total number of starts	1 to 60	Period	1 to 6 h
Number of consecutive starts	1 to 60	T time delay stop/start	0 to 90 min

(1) *Tripping as of 1.2 Is.*

ANSI 67 - Directional Phase Overcurrent			
Characteristic angle	**30°, 45°, 60°**		
	Tripping Time Delay	**Timer Hold**	
Tripping curve	Definite time	DT	
	SIT, LTI, VIT, EIT, UIT (1)	DT	
	RI	DT	
	IEC: SIT/A, LTI/B, VIT/B, EIT/C	DT or IDMT	
	IEEE: MI (D), VI (E), EI (F)	DT or IDMT	
	IAC: I, VI, EI	DT or IDMT	
	Customized	DT	
Is set point	0.1 to 24 I_N	Definite time	Inst; 0.05 s to 300 s
	0.1 to 2.4 I_N	IDMT	0.1 s to 12.5 s at 10 Isr
Timer hold	Definite time (DT; timer hold)		Inst; 0.05 s to 300 s
	IDMT (IDMT; reset time)		0.5 s to 20 s

(1) *Tripping as of 1.2 Is.*

Protection
Setting Ranges

Functions		Settings		Time
ANSI 67N/67NC - Directional Ground Fault, Projection (Type 1)				
Characteristic angle		-45°, 0°, 15°, 30°, 45°, 60°, 90°		
Isr set point		0.01 to 15 I_{Nr} (mini. 0,1 A)	Definite time	Inst; 0.05 s to 300 s
Vsr set point		2 to 80 % of $V_{LL}p$		
Memory time		T0mem time	0; 0.05 s to 300 s	
		Vrmem validity set point	0; 2 to 80 % of $V_{LL}p$	
Measurement origin		Ir input, I'r input		
ANSI 67N/67NC - Directional Ground Fault, According to Ir Vector Magnitude (Type 2)				
Characteristic angle		-45°, 0°, 15°, 30°, 45°, 60°, 90°		
		Tripping Time Delay	**Timer Hold Delay**	
Tripping curve		Definite time	DT	
		SIT, LTI, VIT, EIT, UIT (1)	DT	
		RI	DT	
		IEC: SIT/A, LTI/B, VIT/B, EIT/C	DT or IDMT	
		IEEE: MI (D), VI (E), EI (F)	DT or IDMT	
		IAC: I, VI, EI	DT or IDMT	
		Customized	DT	
Isr set point		0.1 to 15 I_{Nr} (min. 0.1 A)	Definite time	Inst; 0.05 s to 300 s
		0.01 to 1 I_{Nr} (min. 0.1 A)	IDMT	0.1 s to 12.5 s at 10 Isr
Vsr set point		2 to 80 % of $V_{LL}p$		
Timer hold		Definite time (DT; timer hold)		Inst; 0.05 s to 300 s
		IDMT (IDMT; reset time)		0.5 s to 20 s
Measurement origin		Ir input, I'r input or sum of phase currents IrΣ		
ANSI 67N/67NC Type 3 - Directional Ground Fault, According to Ir Vector Magnitude Directionalized on a Tripping Sector				
Tripping sector start angle		0° to 359°		
Tripping sector end angle		0° to 359°		
Isr set point	CSH Zero Sequence CT (2 A rating)	0.1 A to 30 A	Definite time	Inst; 0.05 s to 300 s
	1 A CT	0.005 to 15 I_{Nr} (min. 0.1 A)		
	ZSCT + ACE990 (range 1)	0.01 to 15 I_{Nr} (min. 0.1 A)		
Vsr set point		Calculated Vr (sum of 3 voltages)	2 to 80 % of $V_{LL}p$	
		Measured Vr (external VT)	0.6 to 80 % of $V_{LL}p$	
Measurement origin		Ir input or I'r input		
ANSI 78PS - Pole Slip				
Time delay of the equal-area criterion		0.1 to 300 s		
Maximum number of power swings		1 to 30		
Time between 2 power swings		1 to 300 s		
ANSI 81H - Overfrequency				
Set point and time delay		50 to 55 Hz or 60 to 65 Hz		0.1 to 300 s
Measurement origin		Main channels (V) or additional channels (V')		
ANSI 81L - Underfrequency				
Set point and time delay		40 to 50 Hz or 50 to 60 Hz		0.1 to 300 s
Measurement origin		Main channels (V_{Ln}) or additional channels (V_{Ln}')		
ANSI 81R - Rate of Change of Frequency				
		0.1 to 10 Hz/s		0.15 to 300 s
ANSI 87M - Machine Differential				
Ids set point		0.05 to 0.5 I_N (I_N < 20 A)		
		0.1 to 0.5 I_N (I_N < 20 A)		
ANSI 87T - Transformer Differential				
High set point		3 to 18 I_{N1}		
Percentage-Based Curve				
Ids set point		30 to 100 % I_{N1}		
Slope Id/It		15 to 50 %		
Slope I1/It2		without, 50 to 100 %		
Slope change point		1 to 18 I_{N1}		
Restraint on Energization				
Current threshold		1 to 10 %		
Delay		0 to 300 s		
Restraint on CT loss				
Activity		On / Off		
Restraint on Harmonics Percentage		**Classic**	**Self-Adapting**	
Choice of restraint		Classic	Self-adapting	
High set point		On	On / Off	
Harmonic 2 percentage set point		off, 5 to 40 %		
Harmonic 2 restraint		per phase / total		
Harmonic 5 percentage set point		off, 5 to 40 %		
Harmonic 5 restraint		per phase / total		

Control and Monitoring
Description

Sepam performs all the control and monitoring functions required for electrical network operation:

- the main control and monitoring functions are predefined and fit the most frequent cases of use. They are ready to use and are implemented by simple parameter setting after the necessary logic inputs / outputs are assigned.
- the predefined control and monitoring functions can be adapted for particular needs using the SFT2841 software, which offers the following customization options:
  - logic equation editor, to adapt and complete the predefined control and monitoring functions
  - creation of personalized messages for local annunciation
  - creation of personalized mimic diagrams corresponding to the controlled devices
  - customization of the control matrix by changing the assignment of output relays, LEDs and annunciation messages
- with the Logipam option, Sepam can provide the most varied control and monitoring functions, programmed using the SFT2885 programming software that implements the Logipam ladder language

Operating Principle

Processing control and monitoring functions can be broken down into three phases:

- acquisition of input data:
  - results of protection function processing
  - external logic data, connected to the logic inputs of an optional MES120 input / output module
  - local control commands transmitted by the mimic-based UMI
  - remote control commands (TC) received via the Modbus communication link
- actual processing of the control and monitoring function
- utilization of the processing results:
  - activation of output relays to control a device
  - information sent to the facility manager:
    - by message and/or LED on the Sepam display and SFT2841 software
    - by remote indication (TS) via the Modbus communication link
    - by real-time indications on device status on the animated mimic diagram

PE50249

Maximum Sepam Series 80 configuration with 3 MES120 modules: 42 inputs and 23 outputs.

Logic Inputs and Outputs

The number of Sepam inputs/outputs must be adapted to fit the control and monitoring functions used. The five outputs included in the Sepam Series 80 base unit may be extended by adding one, two, or three MES120 modules with 14 logic inputs and 6 output relays.

After the number of MES120 modules required for the needs of an application is set, the logic inputs are assigned to functions. The functions are chosen from a list which covers the whole range of possible uses. The functions are adapted to meet needs within the limits of the logic inputs available. The inputs may also be inverted for undervoltage type operation.

A default input / output assignment is proposed for the most frequent uses.

Control and Monitoring
Description of Predefined Functions

Each Sepam contains the appropriate predefined control and monitoring functions for the chosen application.

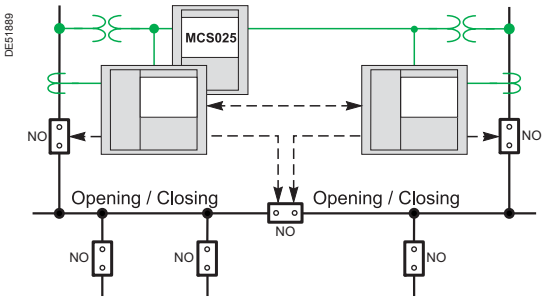
ANSI 94/69 - Circuit Breaker/Contactor Control
This function provides control of breaking devices equipped with different types of closing and tripping coils:
- circuit breakers with shunt or undervoltage trip coils
- latching contactors with NO contacts
- contactors with latched commands.

The function processes all interrupting device closing and tripping conditions, based on:
- protection functions
- interrupting device status data
- remote control commands
- specific control functions for each application (e.g. recloser, synchro-check)

The function also blocks interrupting device closing according to the operating conditions.

Automatic Transfer (AT)
This function transfers bus supply from one source to another. It concerns substations with two mains, with or without tie breakers.

The function carries out:
- automatic transfer with a break if there is a loss of voltage or a fault
- manual transfer and return to normal operation without a break, with or without synchro-check
- control of the tie breaker circuit breaker (optional)
- selection of the normal operating mode
- the necessary logic to ensure that at the end of the sequence, only one circuit breaker out of two or two out of three are closed.



Automatic transfer with synchro-check controlled by Sepam Series 80.

The function is distributed between the two Sepam units protecting the two mains. The synchro-check function (ANSI 25) is carried out by the optional MCS025 module, in conjunction with one of the two Sepam units.

Load shedding - Automatic restart

Automatic load regulation on electrical networks by load shedding followed by automatic restarting of motors connected to the network

Load Shedding
The interrupting device opens to stop motors in case of:
- detection of a network voltage sag by the positive sequence undervoltage protection function ANSI 27D
- receipt of a load shedding command on a logic input.

Automatic Restart

The motors disconnected as a result of the network voltage sag are automatically restarted:
- after the return of network voltage is detected by the positive sequence undervoltage protection function ANSI 27D
- and a time delay has run out, so as to stagger motor restarts.

De-Excitation
Interruption of a synchronous generator's excitation supply and tripping of the generator interrupting device in case of:
- detection of an internal generator fault
- detection of an excitation system fault
- receipt of a de-excitation command on a logic input or via the communication link.

Genset Shutdown
Shutdown of the driving machine, tripping of the interrupting device and interruption of the generator excitation supply in case of:
- detection of an internal generator fault
- receipt of a genset shutdown command on a logic input or via the communication link.

Control of Capacitor Banks
This function controls 1 to 4 switches for capacitor steps, taking into account all the closing and tripping conditions determined by the ANSI 94/69 function for control of the switchgear. Manual or automatic control, controlled by an external reactive-energy regulator.

ANSI 68 - Zone Sequence Interlocking (ZSI)
This function provides:
- perfect tripping coordination with line-to-line and line-to-ground short-circuits, on all types of network
- faster tripping of the breakers closest to the source (solving the drawback of conventional time coordination).

Each Sepam is capable of:
- sending a blocking input when a fault is detected by the phase overcurrent and ground fault protection functions, which may or may not be directional (ANSI 50/51, 50N/51N, 67 or 67N/67NC)
- and receiving blocking inputs which block protection tripping. A saving mechanism ensures continued operation of the protection in the event of a blocking link malfunction.

ANSI 86 - Latching/Acknowledgement
The tripping outputs for all the protection functions and all the logic inputs can be latched individually. The latched information is saved in the event of an auxiliary power outage. (The logic outputs cannot be latched.)

All the latched data may be acknowledged:
- locally, with the key

- remotely via a logic input
- or via the communication link

The Latching/acknowledgement function, when combined with the circuit breaker/contactor control function, can be used to create the ANSI 86 "Lockout relay" function.

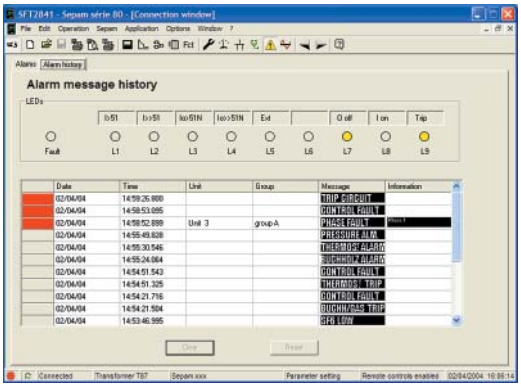
Output Relay Testing
Each output relay is activated for 5 seconds, to make it simpler to check output connections and connected switchgear operation.

3

PE50287

Local indications on the Sepam front panel.

PE50274



SFT2841: alarm history.

ANSI 30 - Local Annunciation

LED Indication

- 2 LEDs, on the front and back of Sepam, indicate the unit operating status, and are visible when a Sepam without a UMI is mounted inside the LV compartment, with access to connectors:
  - green LED ON: Sepam on
  - red "key" LED: Sepam unavailable (initialization phase or detection of an internal failure)
- 9 yellow LEDs on the Sepam front panel:
  - pre-assigned and identified by standard removable labels
  - the SFT2841 software tool may be used to assign LEDs and personalize labels.

Local Annunciation on Sepam Display

Events and alarms may be indicated locally on Sepam's advanced UMI or on the mimic-based UMI by:

- messages on the display unit, available in 2 languages:
  - English, factory-set messages, not modifiable
  - local language, according to the version delivered (the language version is chosen when Sepam is set up)
- one of the 9 yellow LEDs lights up, according to the LED assignment, which is set using SFT2841

Alarm Processing

When an alarm appears, the related message replaces the current display and the related LED goes on.

The number and type of messages depend on the type of Sepam. The messages are linked to Sepam functions and may be viewed on the front-panel display and in the SFT2841 "Alarms" screen.

- to clear the message from the display, press the key
- after the fault has disappeared, press the key: the light goes off and Sepam is reset
- the list of alarm messages remains accessible (⚠ key) and may be cleared by pressing the clear key

Control and Monitoring
Description of Predefined Functions

PE50486

Local control using the mimic-based UMI.

Local Control Using the Mimic-Based UMI

Sepam Control Mode

A key-switch on the mimic-based UMI is used to select the Sepam control mode. Three modes are available : Remote, Local or Test.

In Remote mode:

- remote control commands are taken into account
- local control commands are disabled, with the exception of the circuit-breaker open command.

In Local mode:

- remote control commands are disabled, with the exception of the circuit-breaker open command
- local control commands are enabled.

Test mode should be selected for tests on equipment, e.g. during preventive-maintenance operations:

- all functions enabled in Local mode are available in Test mode
- no remote indications (TS) are sent via the communication link.

The Logipam programming software can be used to customize control-mode processing.

View Device Status on the Animated Mimic Diagram

For local control of devices, all information required by operators can be displayed simultaneously on the mimic-based UMI:

- single-line diagram of the equipment controlled by Sepam, with an animated, graphic indication of device status in real time
- the desired current, voltage and power measurements.

The local-control mimic diagram can be customized by adapting one of the supplied, predefined diagrams or by creating a diagram from scratch.

Local control of devices

All the devices for which opening and closing are controlled by Sepam can be controlled locally using the mimic-based UMI. The most common interlock conditions can be defined be logic equations or by Logipam.

The sure and simple operating procedure is the following:

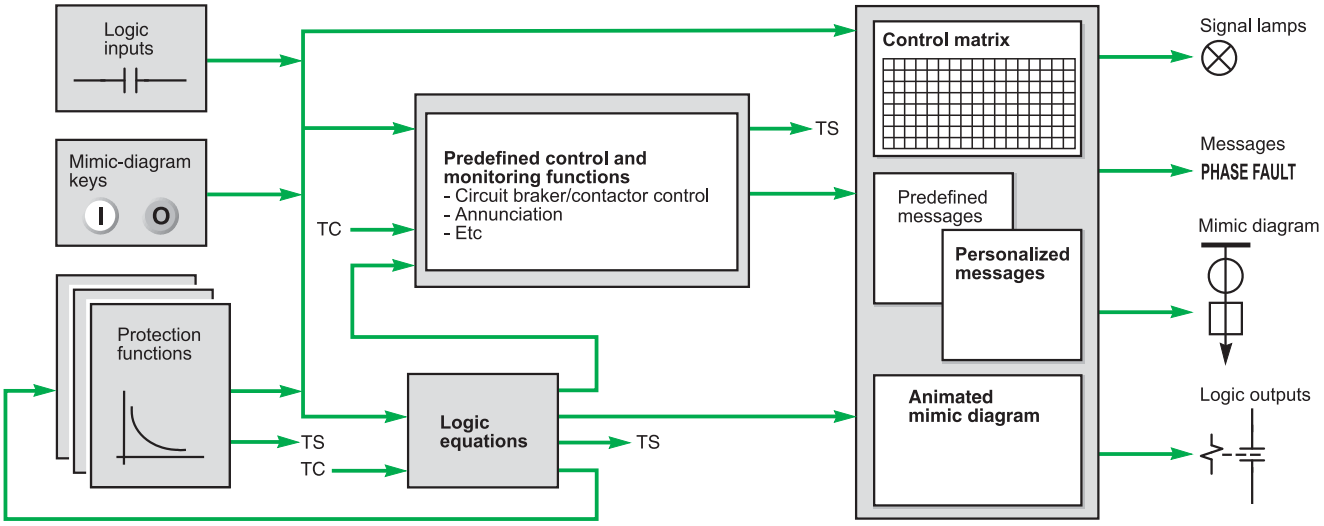
- select the device to be controlled by moving the selection window using the keys or . Sepam checks whether local control of the selected device is authorized and informs the operator (selection window with a solid line)
- selection confirmation for the device to be controlled by pressing the key (the selection window flashes)
- device control by pressing:
  - key : open command
  - or key : close command.

Control and Monitoring
Adaptation of Predefined Functions Using the SFT2841 Software

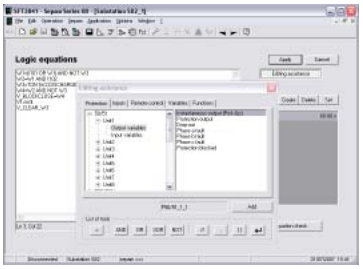
The predefined control and monitoring functions can be adapted for particular needs using the SFT2841 software, which offers the following customization options:
- logic equation editor, to adapt and complete the predefined control and monitoring functions
- creation of personalized messages for local annunciation
- creation of custom mimic diagrams corresponding to the controlled devices
- customization of the control matrix by changing the assignment of output relays, LEDs and annunciation messages

Operating Principle

DE51890



PE50277



SFT2841: logic equation editor.

Logic Equation Editor

The logic equation editor included in the SFT2841 software can be used to:
- complete protection function processing:
  - additional interlocking
  - conditional blocking/validation of functions
- adapt predefined control functions: particular circuit breaker or recloser control sequences

Note that the use of the logic equation editor excludes the possibility of using the Logipam programming software.

A logic equation is created by grouping logic input data received from:
- protection functions
- logic inputs
- local control commands transmitted by the mimic-based UMI
- remote control commands

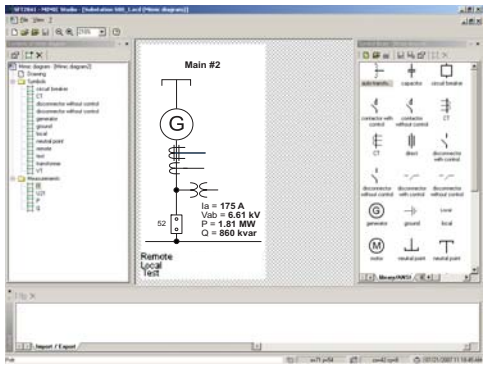
using the Boolean operators AND, OR, XOR, NOT, and automation functions such as time delays, bistables and time programmer.
Equation input is assisted and syntax checking is done systematically.

The result of an equation may then be:
- assigned to a logic output, LED or message via the control matrix
- transmitted by the communication link, as a new remote indication
- utilized by the circuit breaker/contactor control function to trip, close or block interrupting device closing
- used to block or reset a protection function

Control and Monitoring
Adaptation of Predefined Functions Using the SFT2841 Software

Personalized Alarm and Operating Messages
The alarm and operating messages may be personalized using the SFT2841 software tool. The new messages are added to the list of existing messages and may be assigned via the control matrix for display:
- on the Sepam display
- in the SFT2841 "Alarms" and "Alarm History" screens.

PE50492

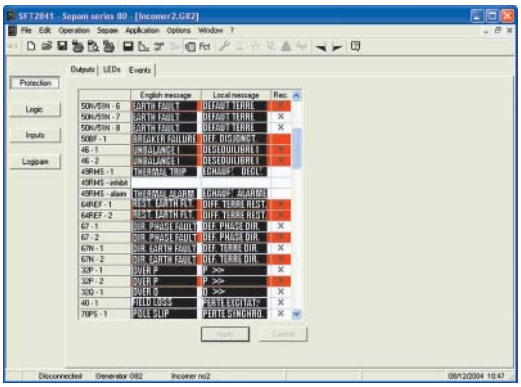


SFT2841: mimic-diagram editor.

Local-Control Mimic Diagram
The mimic-diagram editor in the SFT2841 software can be used to create a single-line diagram corresponding exactly to the equipment controlled by Sepam. Two procedures are available:
- rework a diagram taken from the library of standard diagrams in the SFT2841 software
- creation of an original diagram : graphic creation of the single-line diagram, positioning of symbols for the animated devices, insertion of measurements, text, etc.

Creation of a customized mimic diagram is made easy:
- library of predefined symbols: circuit breakers, grounding switch, etc.
- creation of personalized symbols.

PE50490



SFT2841: control matrix.

Control Matrix
The control matrix is a simple way to assign data from:
- protection functions
- control and monitoring functions
- logic inputs
- logic equations or Logipam program

to the following output data:
- output relays
- 9 LEDs on the front panel of Sepam
- messages for local annunciation
- triggering of disturbance recording.

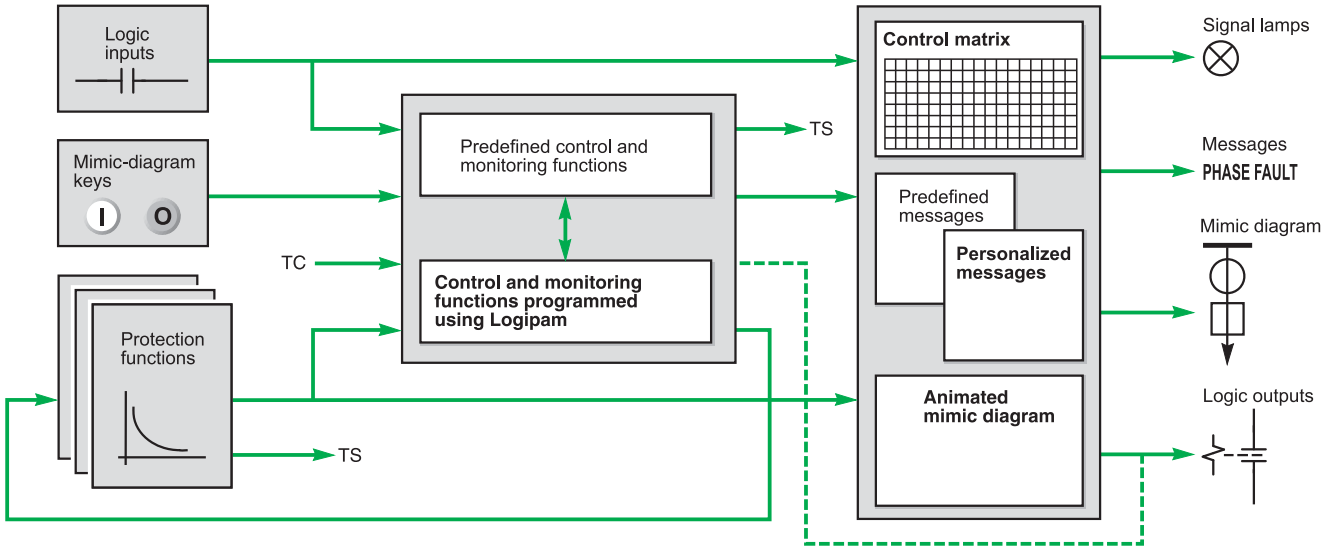
Control and Monitoring
Customized Functions Using Logipam

The SFT2885 programming software (Logipam) can be used to enhance Sepam by programming specific control and monitoring functions.

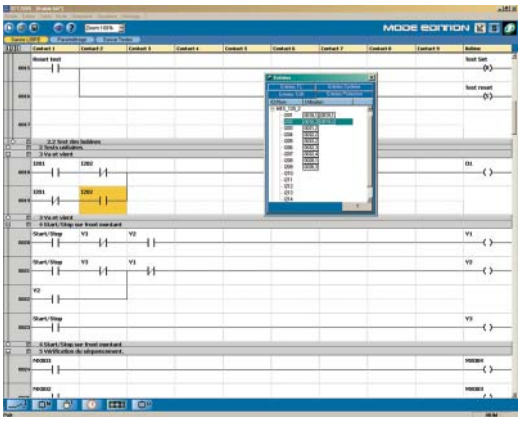
Only the Sepam Series 80 with a cartridge containing the Logipam SFT080 option can run the control and monitoring functions programmed by Logipam.

Operating Principle

DE51891



PE50257



SFT2885: Logipam programming software.

Logipam Programming Software

The Logipam SFT2885 programming software can be used to:
- adapt predefined control and monitoring functions
- program specific control and monitoring functions, either to replace the predefined versions or to create completely new functions, to provide all the functions required by the application

It is made up of:
- a ladder-language program editor used to address all Sepam data and to program complex control functions
- a simulator for complete program debugging
- a code generator to run the program on Sepam

The ladder-language program and the data used can be documented and a complete file can be printed.

Offering more possibilities than the logic-equation editor, Logipam can be used to create the following functions :
- specific automatic transfer functions
- motor starting sequences.

It is not possible to combine the functions programmed by Logipam with functions adapted by the logic-equation editor in a given Sepam.

The Logipam program uses the input data from:
- protection functions
- logic inputs
- remote control commands
- local control commands transmitted by the mimic-based UMI

The result of Logipam processing may then be:
- assigned to a logic output, directly or via the control matrix
- assigned to a LED or message via the control matrix
- transmitted by the communication link, as a new remote indication
- used by the predefined control and monitoring functions
- used to block or reset a protection function

Base Unit
Presentation

Base units are defined according to the following characteristics:
- *type of User-Machine Interface (UMI)*
- *working language*
- *type of base unit connector*
- *type of current sensor connector*
- *type of voltage sensor connector*

PE50472

Sepam Series 80 base unit with integrated advanced UMI.

PE50473

Sepam Series 80 base unit with mimic-based UMI.

PE50127

Customized advanced UMI.

User-Machine Interface

Two types of User-Machine Interfaces (UMI) are available for Sepam Series 80 base units:
- mimic-based UMI
- advanced UMI

The advanced UMI can be integrated in the base unit or installed remotely on the enclosure. Integrated and remote advanced UMIs offer the same functions.

A Sepam Series 80 with a remote advanced UMI is made up of:
- a base unit without any UMI, for mounting inside the LV compartment
- a remote advanced UMI (DSM303)
  - for flush mounting on the front panel of the cubicle in the location most suitable for the facility manager
  - for connection to the Sepam base unit using a prefabricated CCA77x cable

The characteristics of the remote advanced UMI module (DSM303) are presented on page 152.

Comprehensive Data for Facility Managers

All the data required for local equipment operation may be displayed on demand:
- display of all measurement and diagnosis data in numerical format with units and/or in bar graphs
- display of operating and alarm messages, with alarm acknowledgment and Sepam resetting
- display of the list of activated protection functions and the main settings of major protection functions
- adaptation of activated protection function set points or time delays in response to new operating constraints
- display of Sepam and remote module versions
- output testing and logic input status display
- display of Logipam data: status of variables, timers
- entry of two passwords to protect parameter and protection settings

Local Control of Devices Using the Mimic-Based UMI

The mimic-based UMI provides the same functions as the advanced UMI as well as local control of devices:
- selection of the Sepam control mode
- view device status on the animated mimic diagram
- local opening and closing of all the devices controlled by Sepam

Ergonomic Data Presentation

- keypad keys identified by pictograms for intuitive navigation
- menu-guided access to data
- graphical LCD screen to display any character or symbol
- excellent display quality under all lighting conditions, such as automatic contrast setting and backlit screen (user activated)

Working Language

All the texts and messages displayed on the advanced UMI or on the mimic-based UMI are available in two languages:
- English, the default working language
- and a second language, which may be
  - French
  - Spanish
  - U.S. English (ANSI)
  - another "local" language

Please contact a representative about local language customization.

Connecting Sepam to the Parameter Setting Tool

The SFT2841 parameter setting tool is required for Sepam protection and parameter setting. A PC containing the SFT2841 software is connected to the RS232 communication port on the front of the unit.

Base Unit
Presentation

Selection Guide

Base Unit	With Remote Advanced UMI	With Integrated Advanced UMI	With Mimic-Based UMI
	PE50260	PE50262	PE50475
Functions			
Local Indication			
Metering and diagnosis data	■	■	■
Alarms and operating messages	■	■	■
List of activated protection functions	■	■	■
Main protection settings	■	■	■
Version of Sepam and remote modules	■	■	■
Status of logic inputs	■	■	■
Logipam data	■	■	■
Switchgear status on the animated mimic diagram			■
Phasor diagram of currents or voltages			■
Local Control			
Alarm acknowledgement	■	■	■
Sepam reset	■	■	■
Output testing	■	■	■
Selection of Sepam control mode			■
Device open/close command			■
Characteristics			
Screen			
Size	128 x 64 pixels	128 x 64 pixels	128 x 240 pixels
Automatic contrast setting	■	■	■
Backlit screen	■	■	■
Keypad			
Number of keys	9	9	14
Control-mode switch			Remote / Local / Test
LEDs			
Sepam operating status	■ base unit: 2 LEDs visible on back ■ remote advanced UMI: 2 LEDs visible on front	2 LEDs, visible from front and back	2 LEDs, visible from front and back
Indication LEDs	9 LEDs on remote advanced UMI	9 LEDs on front	9 LEDs on front
Mounting			
	■ bare base unit, mounted at the back of the compartment using the AMT880 mounting plate ■ DSM303 remote advanced UMI module , flush mounted on the front of the cubicle and connected to the base unit with the CCA77x prefabricated cable	Flush mounted on front of cubicle	Flush mounted on front of cubicle

Base Unit
Presentation

PE50663

Sepam Series 80 memory cartridge and backup battery.

Hardware Characteristics

Removable Memory Cartridge

The cartridge contains all the Sepam characteristics:
- all Sepam protection and parameter settings
- all the metering and protection functions required for the application
- predefined control functions
- functions customized by control matrix or logic equations
- functions programmed by Logipam (optional)
- personalized local-control mimic diagram
- accumulated energies and switchgear diagnosis values
- working languages, customized and otherwise

It may be made tamper-proof by lead sealing. It is removable and easy to access on the front panel of Sepam to reduce maintenance time. If a base unit malfunctions, simply:
- switch off Sepam and unplug connectors
- retrieve original cartridge
- replace the faulty base unit by a spare base unit (without cartridge)
- load the original cartridge into the new base unit
- plug in the connectors and switch Sepam on again

Sepam is operational, with all its standard and customized functions, without requiring any reloading of protection and parameter settings.

Backup Battery

Standard lithium battery, 1/2 AA format, 3.6 Volts. It allows the following data to be stored in the event of an auxiliary power outage:
- time-stamped event tables
- disturbance recording data
- maximum demands, tripping context, etc
- date and time

The battery presence and charge are monitored by Sepam. The main data (protection and parameter settings) are saved in the event of an auxiliary power outage, regardless of the state of the battery.

Auxiliary Power Supply

DC power supply voltage from 24 to 250 V DC.

Five Relay Outputs

The five relay outputs O1 to O5 on the base unit must be connected to connector Ⓐ. Each output can be assigned to a predetermined function using the SFT2841 software. O1 to O4 are 4 control outputs with one NO contact, used by default for the switchgear control function:
- O1: switchgear tripping
- O2: switchgear closing blocking
- O3: switchgear closing
- O4: available

O5 is an indication output used by default for the watchdog function and has two contacts, one NC and one NO.

Base Unit
Presentation

PE50666

Main Connector, Voltage, and Residual Current Input Connectors
A choice of two types of removable, screw-lockable 20-pin connectors:
- CCA620 screw-type connectors
- or CCA622 ring lug connectors

The presence of the connector is monitored.

Connector for Additional Voltage Inputs (Sepam B83)
CCT640 connector, removable and screw-lockable. The presence of the CCT640 connector is monitored.

Phase Current Input Connectors
Current sensors connected to removable, screw-lockable connectors according to type of sensors used:
- CCA630 or CCA634 connector for 1 A or 5 A current transformers
- or CCA671 connector for LPCT sensors

The presence of these connectors is monitored.

Mounting Accessories

Spring Clips
8 spring clips are supplied with the base unit to flush-mount Sepam in mounting plates 0.059 to 0.236 in (1.5 to 6 mm) thick. Simple, tool-free installation.

AMT880 Mounting Plate
It is used to mount a Sepam without UMI inside the compartment with access to connectors on the rear panel. Mounting used with remote advanced UMI module (DSM303).

AMT820 Blanking Plate
It fills in the space left when a standard model Sepam 2000 is replaced by a Sepam Series 80.

Spare Base Units
The following spares are available to replace faulty base units:
- base units with or without UMI, without cartridge or connectors
- all types of standard cartridges, with or without the Logipam option.

AMT852 Lead Sealing Accessory
The AMT852 lead sealing accessory can be used to prevent unauthorized modification of the settings of Sepam Series 80 units with integrated advanced UMIs. The accessory includes:
- a lead-sealable cover plate
- the screws required to secure the cover plate to the integrated advanced UMI of the Sepam unit.

Note: *The AMT852 lead sealing accessory can secured only to the integrated advanced UMIs of Sepam Series 80 units Contact us to determine the serial number of the device on which you can fit the lead sealing accessory.*

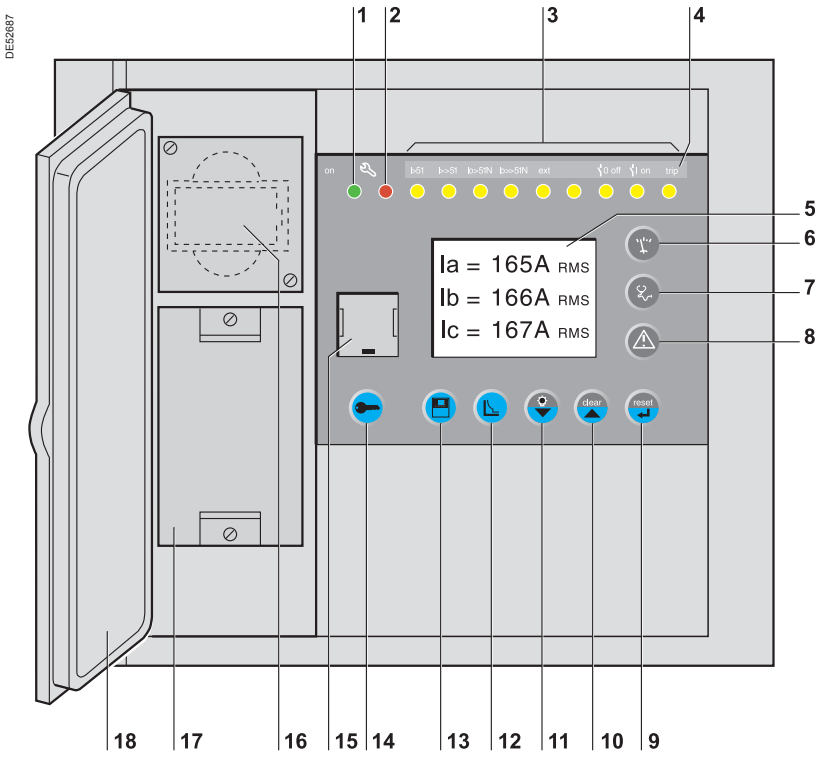
Base Unit
Description

Front Panel with Advanced UMI

1 Green LED: Sepam on.
2 Red LED: Sepam unavailable.
3 9 yellow indication LEDs.
4 Label identifying the indication LEDs.

5 Graphical LCD screen.
6 Display of measurements.
7 Display of switchgear, network and machine diagnosis data.
8 Display of alarm messages.
9 Sepam reset (or confirm data entry).
10 Acknowledgement and clearing of alarms (or move cursor up).
11 LED test (or move cursor down).
12 Display and adaptation of activated protection settings.
13 Display of Sepam and Logipam data.
14 Entry of 2 passwords.
15 RS232 PC connection port.

16 Backup battery.
17 Memory cartridge.
18 Door.

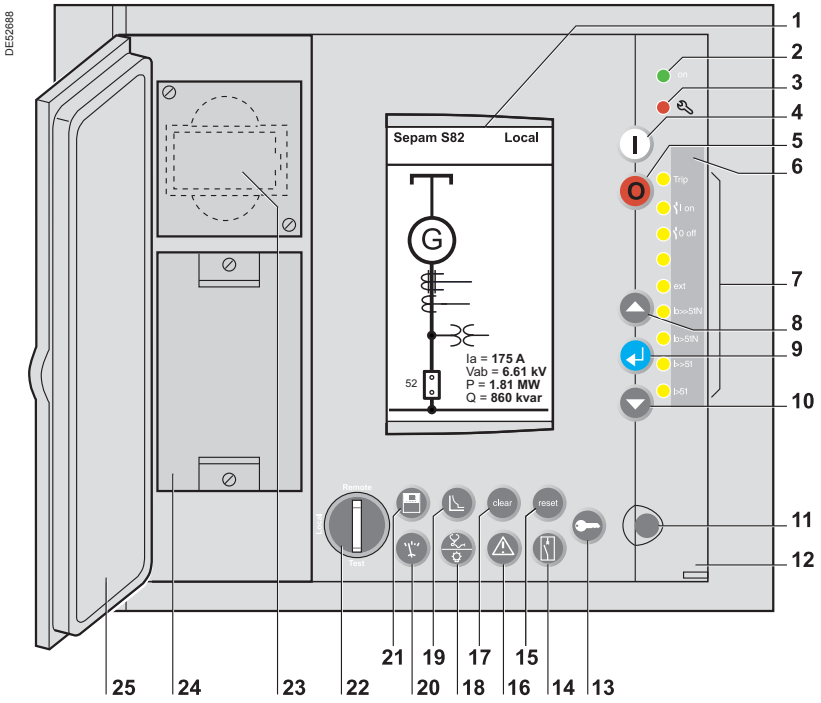


Front Panel with Mimic-Based UMI

1 Graphical LCD screen.
2 Green LED: Sepam on.
3 Red LED: Sepam unavailable.
4 Local close command.
5 Local open command.
6 Label identifying the indication LEDs.
7 9 yellow indication LEDs.
8 Move cursor up.
9 Confirm data entry.
10 Move cursor down.
11 RS232 PC connection port.
12 Transparent door.

13 Entry of 2 passwords.
14 Mimic-based UMI display.
15 Sepam reset.
16 Display of alarm messages.
17 Acknowledgement and clearing of alarms.
18 Display of switchgear and network diagnosis data (or LED test).
19 Display and adaptation of activated protection settings.
20 Display of measurements.
21 Display of Sepam and Logipam data.
22 Three-position key switch to select Sepam control mode.

23 Backup battery.
24 Memory cartridge.
25 Door.



Base Unit
Description

1 Base unit.
2 8 fixing points for 4 spring clips.
3 Red LED: Sepam unavailable.
4 Green LED: Sepam on.
5 Gasket.

(A) 20-pin connector for:
- 24 V DC to 250 V DC auxiliary supply
- 5 relay outputs.

(B1) Connector for 3 phase current Ia, Ib, Ic inputs.

(B2) Sepam T87, M87, M88, G87, G88:
- connector for 3-phase current I'a, I'b, I'c inputs

Sepam B83:
- connector for
  - 3 phase voltage V'an, V'bn, V'cn inputs
  - 1 residual voltage V'r input.

Sepam C86:
- connector for capacitor unbalance current inputs.

(C1) Modbus communication port 1.

(C2) Modbus communication port 2.

(D1) Remote module connection port 1.

(D2) Remote module connection port 2.

(E) 20-pin connector for:
- phase voltage Van, Vbn, Vcn inputs
- 1 residual voltage Vr input.
- 2 residual current Ir, I'r inputs.

(F) Spare port.

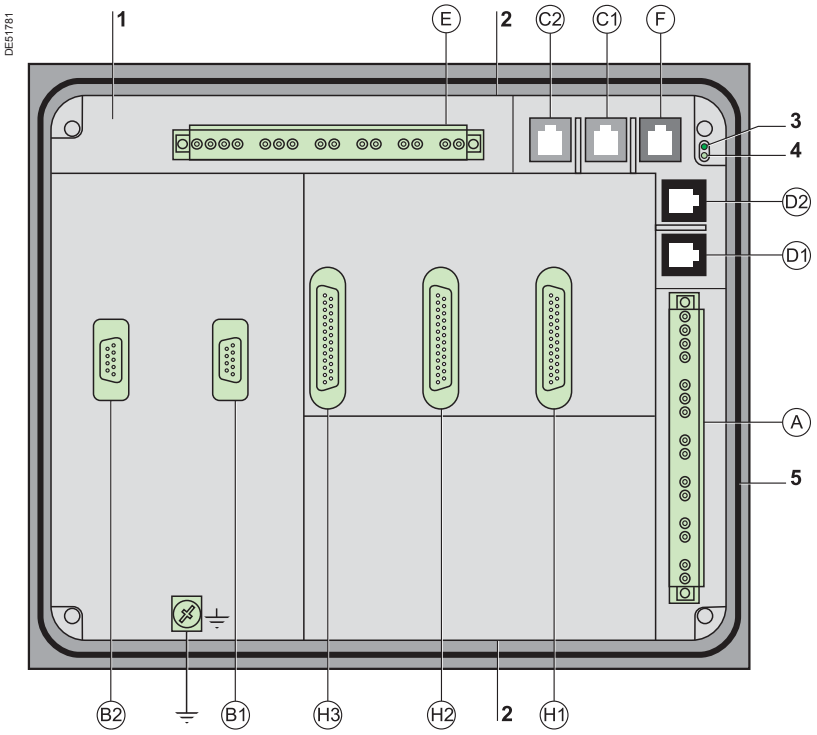
(H1) Connector for 1st MES120 input/output module.

(H2) Connector for 2nd MES120 input/output module.

(H3) Connector for 3rd MES120 input/output module.

⏚ Functional ground.

Rear Panel



Base Unit
Technical Characteristics

Weight

	Base Unit with Advanced UMI	Base Unit with Mimic-Based UMI
Minimum weight (base unit without MES120)	5.29 lb (2.4 kg)	6.61 lb (3.0 kg)
Maximum weight (base unit with 3 MES120)	8.82 lb (4.0 kg)	10.1 lb (4.6 kg)

Sensor Inputs

Phase Current Inputs	1 A or 5 A CT
Input impedance	< 0.02 W
Consumption	< 0.02 VA (1 A CT) < 0.5 VA (5 A CT)
Continuous thermal withstand	4 In
1 second overload	100 In

Voltage Inputs	Phase	Residual
Input impedance	> 100 k W	> 100 k W
Consumption	< 0.015 VA (100 V VT)	< 0.015 VA (100 V VT)
Continuous thermal withstand	240 V	240 V
1-second overload	480 V	480 V
Isolation of inputs in relation to other isolated groups	Enhanced	Enhanced

Relay Outputs

Control Relay Outputs O1 to O4 and O x 01 (1)

Voltage	DC	24/48 V DC	127 V DC	220 V DC	
	AC (47.5 to 63 Hz)				100 to 240 V AC
Continuous current		8 A	8 A	8 A	8 A
Breaking capacity	Resistive load	8 A / 4 A	0.7 A	0.3 A	
	Load L/R < 20 ms	6 A / 2 A	0.5 A	0.2 A	
	Load L/R < 40 ms	4 A / 1 A	0.2 A	0.1 A	
	Resistive load				8 A
	Load pf > 0.3				5 A
Making capacity		< 15 A for 200 ms			
Isolation of outputs in relation to other isolated groups		Enhanced			

Annunciation Relay Output O5

Voltage	DC	24/48 V DC	127 V DC	220 V DC	
	AC (47.5 to 63 Hz)				100 to 240 V AC
Continuous current		2 A	2 A	2 A	2 A
Breaking capacity	Load L/R < 20 ms	2 A / 1 A	0.5 A	0.15 A	
	Load pf > 0.3				1 A
Isolation of outputs in relation to other isolated groups		Enhanced			

Power Supply

Voltage	24 to 250 V DC	-20 % / +10 %
Maximum consumption	< 16 W	
Inrush current	< 10 A 10 ms	
Acceptable ripple content	12 %	
Acceptable momentary outages	100 ms	

Battery

Format	1/2 AA lithium 3.6 V
Service life	10 years Sepam energized
	8 years Sepam not energized

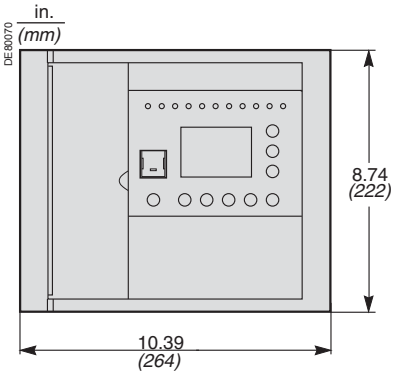
***(1)** Relay outputs complying with clause 6.7 of standard C 97.90 (30 A, 200 ms, 2000 operations)*

Base Unit
Environmental Characteristics

Electromagnetic Compatibility	Standard	Level/Class	Value
Emission Tests			
Disturbing field emission	IEC 60255-25		
	EN 55022	A	
Conducted disturbance emission	IEC 60255-25		
	EN 55022	A	
Immunity Tests – Radiated Disturbances			
Immunity to radiated fields	ANSI C37.90.2		35 V/m; 25 MHz - 1GHz
	IEC 60255-22-3		10 V/m; 80 MHz - 1 GHz
	IEC 61000-4-3	III	10 V/m; 80 MHz - 2 GHz
Electrostatic discharge	ANSI C37.90.3		8 kV air; 4 kV contact
	IEC 60225-22-2		8 kV air; 6 kV contact
Immunity to magnetic fields at network frequency	IEC 61000-4-8	4	30 A/m (continuous) - 300 A/m (1-3 s) (4)
Immunity Tests – Conducted Disturbances			
Immunity to conducted RF disturbances	IEC 60255-22-6	III	10 V
Fast transient bursts	ANSI C37.90.1		4 kV; 2.5 kHz
	IEC 60255-22-4	A and B	4 kV; 2.5 kHz/2 kV, 5 kHz
	IEC 61000-4-4	IV	4 Kv; 2.5 KHz
1 MHz damped oscillating wave	ANSI C37.90.1		2.5 kV CM; 2.5 kV DM
	IEC 60255-22-1		2.5 kV CM; 1 kV DM
100 MHz damped oscillating wave	IEC 61000-4-12		2.5 kV CM; 1 kV DM
Surges	IEC 61000-4-5	III	2 kV CM; 1 kV DM
Voltage interruptions	IEC 60255-11		100 % during 100 ms
Mechanical Robustness	**Standard**	**Level/Class**	**Value**
In Operation			
Vibrations	IEC 60255-21-1	2	1 Gn; 10 Hz - 150 Hz
	IEC 60068-2-6	Fc	2 Hz - 13.2 Hz; a = ±1 mm
Shocks	IEC 60255-21-2	2	10 Gn / 11 ms
Earthquakes	IEC 60255-21-3	2	2 Gn (horizontal axes) 1 Gn (vertical axes)
De-Energized			
Vibrations	IEC 60255-21-1	2	2 Gn; 10 Hz - 150 Hz
Shocks	IEC 60255-21-2	2	27 Gn / 11 ms
Jolts	IEC 60255-21-2	2	20 Gn / 16 ms
Climatic Withstand	**Standard**	**Level/Class**	**Value**
In Operation			
Exposure to cold	IEC 60068-2-1	Ad	-25 °C
Exposure to dry heat	IEC 60068-2-2	Bd	+70 °C
Continuous exposure to damp heat	IEC 60068-2-78	Cab	10 days; 93 % RH ; 40 °C
Salt mist	IEC 60068-2-52	Kb/2	6 days
Influence of corrosion/Gas test 2	IEC 60068-2-60		21 days; 75 % RH; 25 °C; 0.5 ppm H_2S; 1 ppm SO_2
Influence of corrosion/Gas test 4	IEC 60068-2-60		21 days; 75 % HR; 25 °C; 0.01 ppm H_2S; 0.2 ppm SO_2; 0.2 ppm NO_2; 0.01 ppm Cl_2
In Storage (3)			
Temperature variation with specified variation rate	IEC 60068-2-14	Nb	-25 °C at +70 °C; 5 °C/min
Exposure to cold	IEC 60068-2-1	Ab	-25 °C
Exposure to dry heat	IEC 60068-2-2	Bb	+70 °C
Continuous exposure to damp heat	IEC 60068-2-78	Cab	56 days; 93 % RH; 40 °C
	IEC 60068-2-30	Db	6 days; 95 % RH; 55 °C
Safety	**Standard**	**Level/Class**	**Value**
Enclosure Safety Tests			
Front panel tightness	IEC 60529	IP52	Other panels IP20
	NEMA	Type 12	
Fire Resistance	IEC 60695-2-11		650 °C with glow wire
Electrical Safety Tests			
1.2/50 µs pulse wave	IEC 60255-5		5 kV (1)
Power frequency dielectric withstand	ANSI C37.90		1 kV 1 mn (indication output) 1.5 kV 1 mn (control output)
	IEC 60255-5		2 kV 1 mn (2)
Certification			
e	EN 50263 harmonized standard	**European directives:** ■ 89/336/EEC Electromagnetic Compatibility (EMC) Directive □ 92/31/EEC Amendment □ 93/68/EEC Amendment ■ 73/23/EEC Low Voltage Directive □ 93/68/EEC Amendment	
c UL us	UL508 - CSA C22.2 n° 14-95		File E212533
CSA	CSA C22.2 n° 14-95 / n° 94-M91 / n° 0.17-00		File 210625

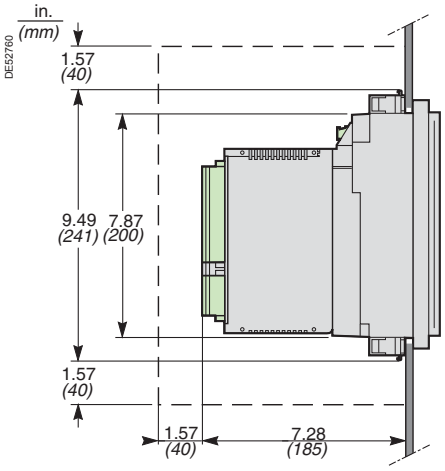
(1) *Except for communication: 3 kV in common mode and 1 kV in differential mode.*
(2) *Except for communication: 1 kVrms.*
(3) *Sepam must be stored in its original packing.*
(4) *Iso > 0.1 Inr for the 50N/51N and 67N□ protection functions, with Ir calculated as the sum of the phase currents.*

Base Unit
Dimensions



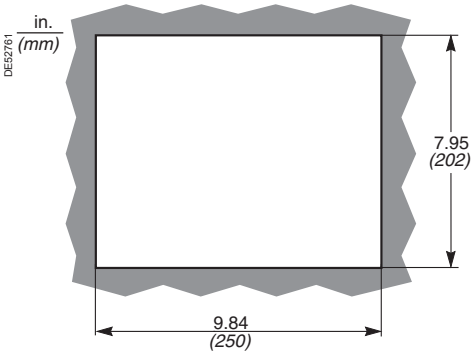
Front view of Sepam

Dimensions

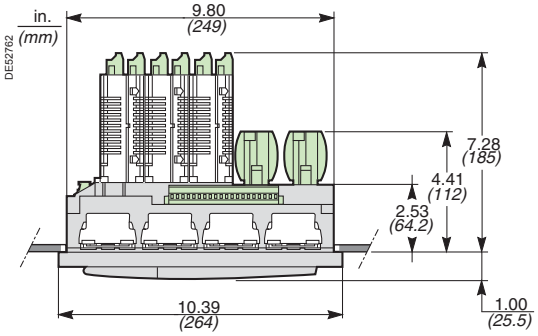


Side view of Sepam with MES120, flush-mounted in front panel with spring clips.
Front panel: 0.05 in to 0.23 in (1.5 mm to 6 mm) thick

Clearance for Sepam assembly and wiring.

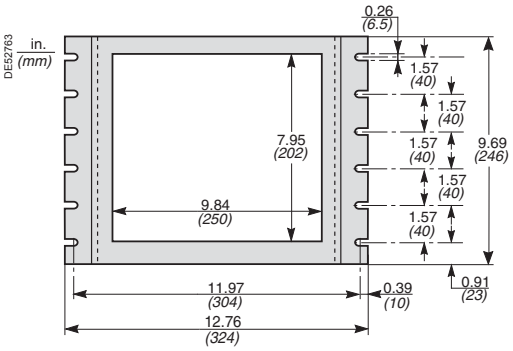


Cut-out.

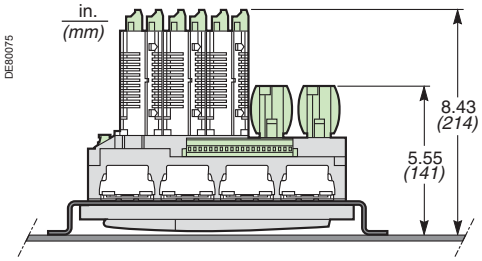


Top view of Sepam with MES120, flush-mounted in front panel with spring clips.
Front panel: 0.05 in to 0.23 in (1.5 mm to 6 mm) thick

Assembly with AMT880 Mounting Plate

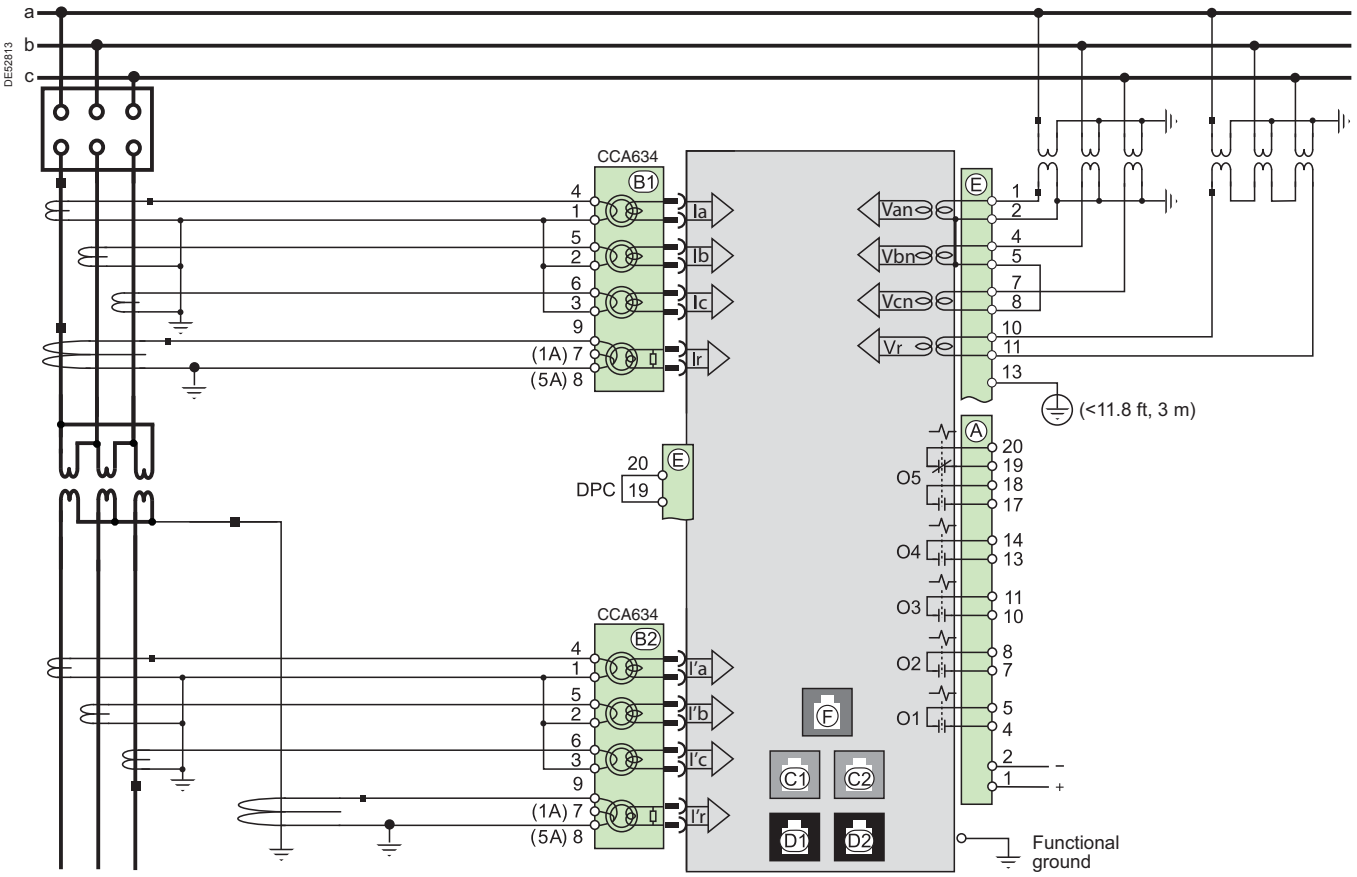


AMT880 mounting plate



Top view of Sepam with MES120, flush-mounted in front panel with spring clips.
Mounting plate: 0.11 in (3 mm) thick.

Base Unit
Sepam Series 80



Base Unit
Connection

Connection Characteristics

Connector	Type	Reference	Wiring
(A), (E)	Screw-type	CCA620	■ wiring with no fittings : □ 1 wire with max. cross-section 0.2 to 2.5 mm² (≥ AWG 24-12) or 2 wires with max. cross-section 0.2 to 1 mm² (≥ AWG 24-16) □ stripped length: 8 to 10 mm (.31 in to .39 in) ■ wiring with fittings: □ recommended wiring with Telemecanique fittings: - DZ5CE015D for 1 x 1.5 mm² wire (AWG 16) - DZ5CE025D for 1 x 2.5 mm² wire (AWG 12) - AZ5DE010D for 2 x 1 mm² wires (AWG 18) □ wire length: 8.2 mm (0.32 in) □ stripped length: 8 mm (0.31 in)
	6.35 mm ring lugs	CCA622	■ 6.35 mm ring or spade lugs (1/4") ■ maximum wire cross-section of 0.2 to 2.5 mm² (≥ AWG 24-12) ■ stripped length: 6 mm (.24 in) ■ use an appropriate tool to crimp the lugs on the wires ■ maximum of 2 ring or spade lugs per terminal ■ tightening torque: 1.2 nm (13.27 lb-in)
(C1), (C2)	Green RJ45 plug		CCA612
(D1), (D2)	Black RJ45 plug		CCA770: L = 0.6 m (2 ft) CCA772: L = 2 m (6.6 ft) CCA774: L = 4 m (13.1 ft) CCA785 for MCS025 module: L = 2 m (6.6 ft)
DES1845 Functional ground	Ring lug		Grounding braid, to be connected to cubicle grounding: ■ flat copper braid with cross-section ⩾ 9 mm² ■ maximum length: 300 mm (11.8 in)
(B1), (B2)	4 mm ring lugs	CCA630, CCA634 for connection of 1 A or 5 A CTs	■ wire cross-section 1.5 to 6 mm² (AWG 16-10) ■ tightening torque: 1.2 Nm (13.27 lb-in)
	RJ45 plug	CCA671, for connecting three LPCT sensors	Integrated with LPCT sensor

CAUTION

LOSS OF PROTECTION OR RISK OF NUISANCE TRIPPING

If the Sepam is no longer supplied with power or is in fail-safe position, the protection functions are no longer active and all the Sepam output relays are dropped out. Check that this operating mode and the watchdog relay wiring are compatible with your installation.

Failure to follow this instruction can result in equipment damage and unwanted shutdown of the electrical installation.

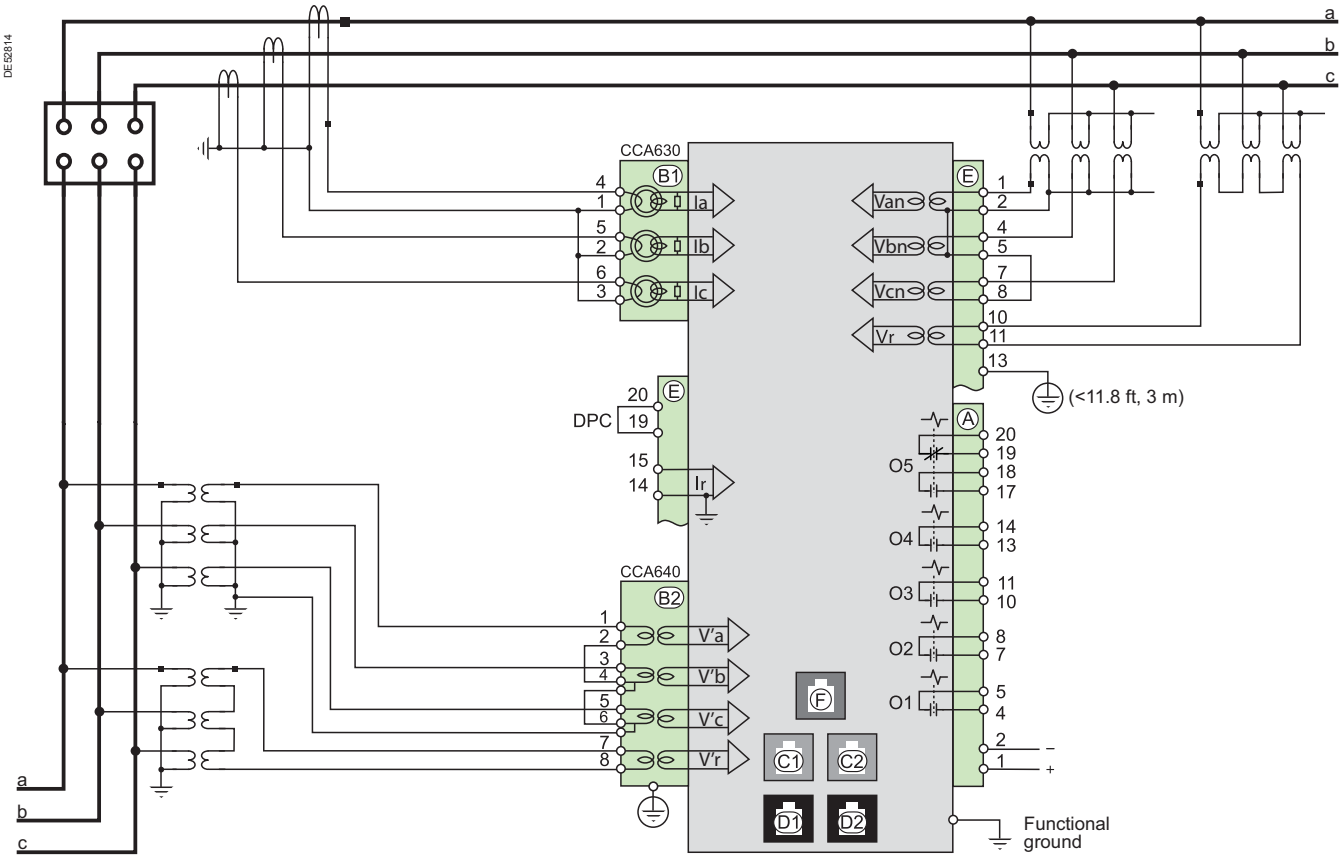
⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions
- NEVER work alone
- Before performing visual inspections, tests, or maintenance of this equipment, disconnect all sources of electric power. Assume that all circuits are live until they have been completely de-energized, tested, and tagged. Pay particular attention to the design of the power system. Consider all sources of power, including the possibility of backfeeding
- Always use a properly rated voltage sensing device to confirm that all power is off
- Start by connecting the device to the protective ground and to the functional ground
- Screw tight all terminals, even those not in use

Failure to follow these instructions will result in death or serious injury.

Base Unit
Sepam B83



Connection Characteristics

Connector	Type	Reference	Wiring
B1	4 mm ring lugs	CCA630, for connection of 1 A or 5 A CTs	1.5 to 6 mm² (AWG 16-10)
B2	Screw-type	CCT640	VT wiring: same as wiring for the CCA620 Grounding connection: by 4 mm ring lug

For connectors A, E, C1, C2, D1, D2, ⏚ : see Page 126.

CAUTION

LOSS OF PROTECTION OR RISK OF NUISANCE TRIPPING

If the Sepam is no longer supplied with power or is in fail-safe position, the protection functions are no longer active and all the Sepam output relays are dropped out. Check that this operating mode and the watchdog relay wiring are compatible with your installation.

Failure to follow this instruction can result in equipment damage and unwanted shutdown of the electrical installation.

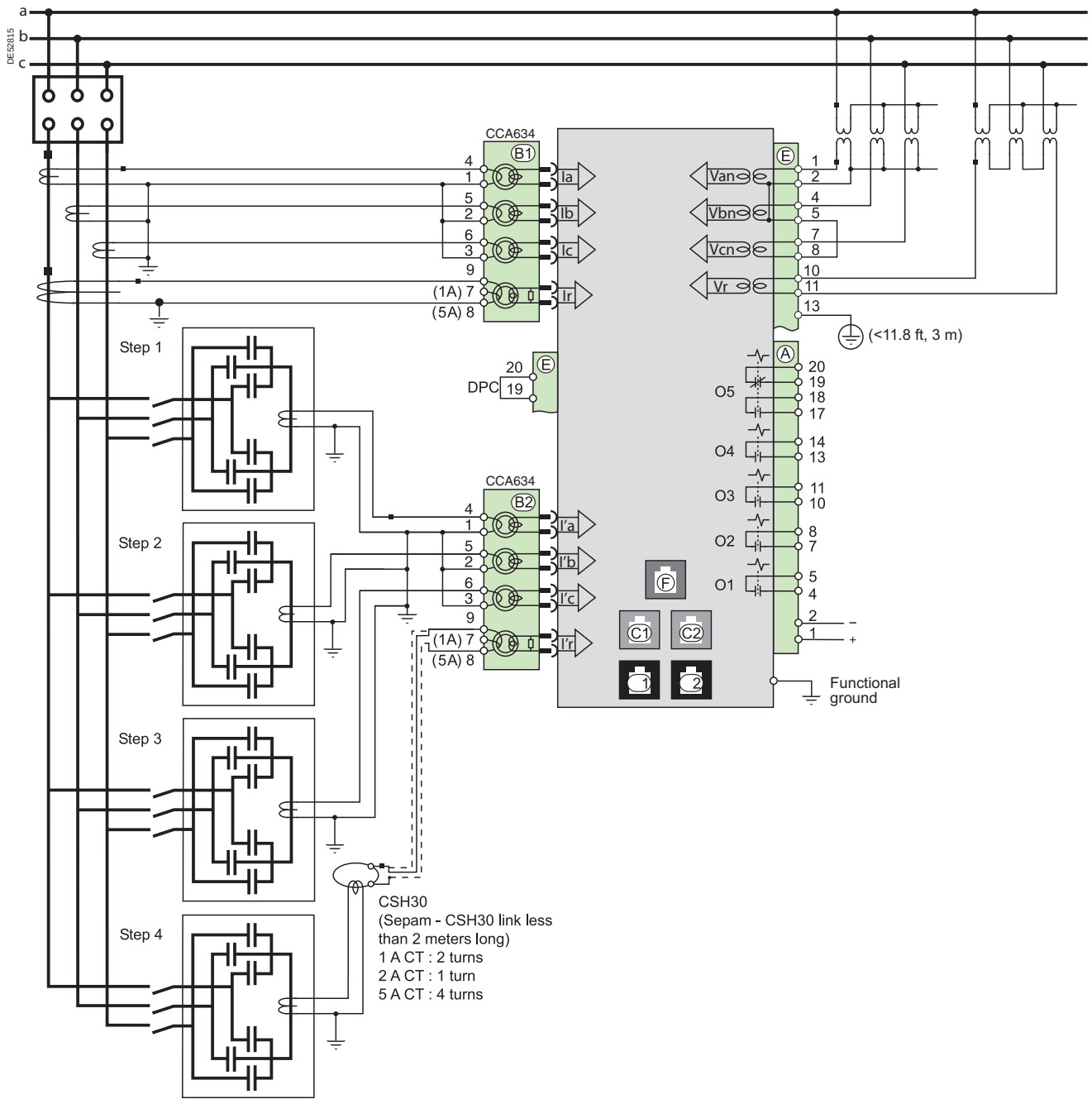
⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions.
- NEVER work alone.
- Before performing visual inspections, tests, or maintenance of this equipment, disconnect all sources of electric power. Assume that all circuits are live until they have been completely de-energized, tested, and tagged. Pay particular attention to the design of the power system. Consider all sources of power, including the possibility of backfeeding
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Start by connecting the device to the protective ground and to the functional ground.
- Screw tight all terminals, even those not in use.

Failure to follow these instructions will result in death or serious injury.

Base Unit
Sepam C86

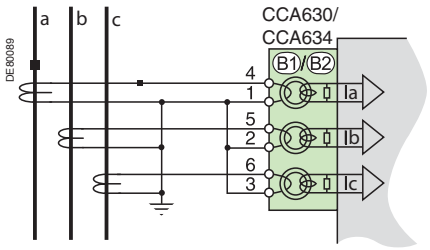


Connector	Type	Reference	Wiring
(B1)	4 mm ring lugs	CCA630, for connection of 1 A or 5 A CTs	1.5 to 6 mm² (AWG 16-10)
	RJ45 plug	CCA671, for connection of 3 LPCT sensors	Integrated with LPCT sensor
(B2)	4 mm ring lugs	CCA630, for connection of 1 A, 2A or 5 A CTs	1.5 to 6 mm² (AWG 16-10)
Functional ground	Ring lugs		Grounding braid, to be connected to cubicle grounding: ■ flat copper braid with cross-section ≥ 9 mm² ■ maximum length: 300 mm

For connectors (A), (E), (C1), (C2), (D1), (D2), : see Page 127.

Base Unit
Phase Current Inputs

Variant 1: Phase Current Measurement by 3 x 1 A or 5 A CTs (standard connection)



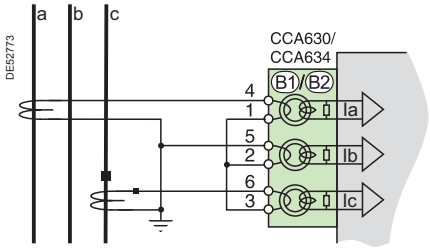
Connection of 3 x 1 A or 5 A sensors to the CCA630 connector.

Measuring the three phase currents allows the calculation of residual current.

Parameters

Sensor type	5 A CT or 1 A CT
Number of CTs	Ia, Ib, Ic
Rated current (In)	1 A to 6250 A

Variant 2: Phase Current Measurement by 2 x 1 A or 5 A CTs



Connection of two 1 A or 5 A sensors to the CCA630 connector.

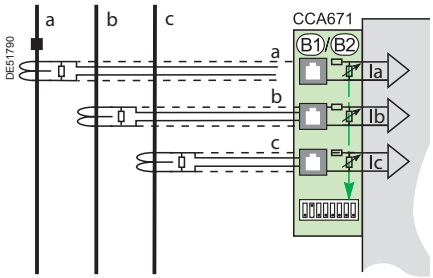
Measuring phase a and c currents is sufficient for all protection functions based on phase current.

This arrangement does not allow the calculation of residual current, nor use of ANSI 87T and 87M differential protection functions on the Sepam T87, M87, M88, G87 and G88.

Parameters

Sensor type	5 A CT or 1 A CT
Number of CTs	Ia, Ic
Rated current (In)	1 A to 6250 A

Variant 3: Phase Current Measurement by three LPCT type sensors



Connecting three Low Power Current Transducer (LPCT) type sensors to the CCA671 connector. Sepam goes into fail-safe position if less than three sensors are connected.

Measuring the three phase currents allows the calculation of residual current.

The In parameter, primary rated current measured by an LPCT, is to be chosen from the following values, in Amps: 25, 50, 100, 125, 133, 200, 250, 320, 400, 500, 630, 666, 1000, 1600, 2000, 3150. The parameter is set in the SFT2841 software. It is completed by hardware setting of the microswitches on the CCA671 connector. It is not possible to use LPCT sensors for the following measurements:

- phase-current measurements for Sepam T87, M88 and G88 with ANSI 87T transformer differential protection (connectors B1 and B2)
- phase-current measurements for Sepam B83 (connector B1)
- unbalance-current measurements for Sepam C86 (connector B2).

Parameters

Sensor type	LPCT
Number of CTs	Ia, Ib, Ic
Rated current (In)	25, 50, 100, 125, 133, 200, 250, 320, 400, 500, 630, 666, 1000, 1600, 2000 or 3150 A

Note: Parameter In must be set twice:

- Software parameter setting using the advanced UMI or the SFT2841 software tool
- Hardware parameter setting using microswitches on the CCA671 connector

Base Unit
Residual Current Inputs

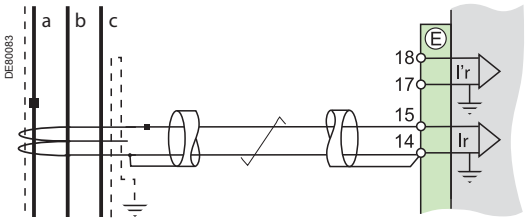
Variant 1: Residual Current Calculation by Sum of Three Phase Currents

Description
Residual current is calculated by the vector sum of the three phase currents Ia, Ib, and Ic, measured by three 1 A or 5 A CTs or by three LPCT type sensors.
See current input connection diagrams.

Parameters

Residual Current	Rated Residual Current	Measuring Range
Sum of three Is	$I_{NR} = I_N$, CT primary current	0.01 to 40 I_{NR} (minimum 0.1 A)

Variant 2: Residual Current Measurement by CSH120 or CSH200 Zero Sequence CT (standard connection)

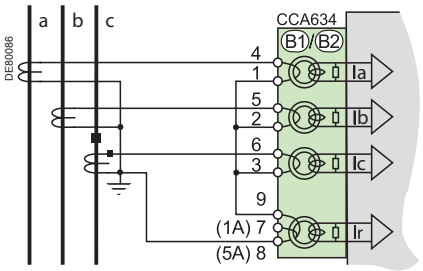


Description
Arrangement recommended for the protection of isolated or compensated neutral systems, in which very low fault currents need to be detected.

Parameters

Residual Current	Rated Residual Current	Measuring Range
2 A rating CSH	I_{NR} = 2 A	0.1 to 40 A
20 A rating CSH	I_{NR} = 20 A	0.2 to 400 A

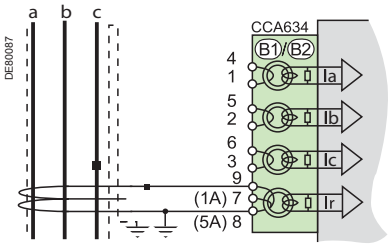
Variant 3: Residual Current Measurement by 1 A or 5 A CTs and CCA634



Description
Residual current measurement by 1 A or 5 A CTs
- Terminal 7: 1 A CT
- Terminal 8: 5 A CT

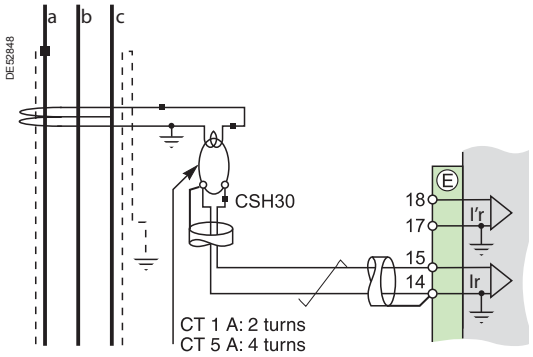
Parameters

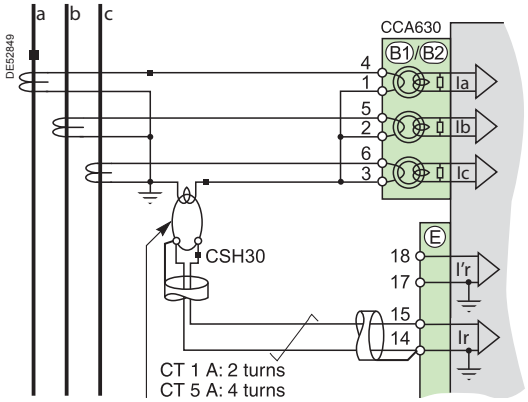
Residual Current	Rated Residual Current	Measuring Range
1 A CT	$I_{NR} = I_N$, CT primary current	0.01 to 20 I_{NR} (minimum 0.1 A)
5 A CT	$I_{NR} = I_N$, CT primary current	0.01 to 20 I_{NR} (minimum 0.1 A)



Base Unit
Residual Current Inputs

Variant 4: Residual Current Measurement by 1 A or 5 A CTs and CSH30 Interposing Ring CT





Description

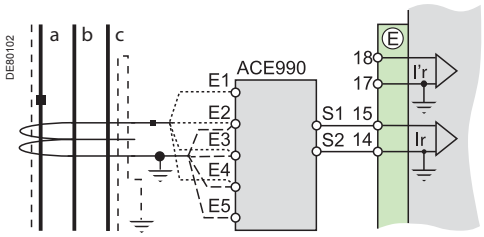
The CSH30 interposing ring CT is used to connect 1 A or 5 A CTs to Sepam to measure residual current:

- CSH30 interposing ring CT connected to 1 A CT: make 2 turns through CSH primary
- CSH30 interposing ring CT connected to 5 A CT: make 4 turns through CSH primary.

Parameters

Residual Current	Rated Residual Current	Measuring Range
1 A CT	$I_{NR} = I_N$, CT primary current	0.01 to 20 I_{NR} (minimum 0.1 A)
5 A CT	$I_{NR} = I_N$, CT primary current	0.01 to 20 I_{NR} (minimum 0.1 A)

Variant 5: Residual Current Measurement by Zero Sequence CT with Ratio of 1/n (n between 50 and 1500)



Description

The ACE990 is used as an interface between a MV zero sequence CT with a ratio of 1/n (50 ⩽ n ⩽ 1500) and the Sepam residual current input. This arrangement allows the continued use of existing zero sequence CTs on the installation.

Parameters

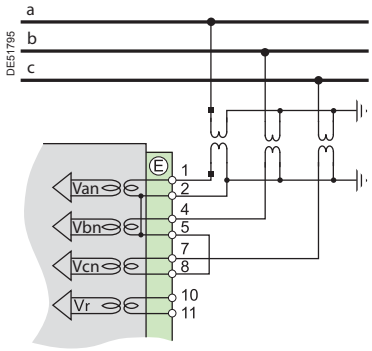
Residual Current	Rated Residual Current	Measuring Range
ACE990 - range 1 (0.00578 ≤ k ≤ 0.04)	$I_{NR} = Ik.n$ (1)	0.01 to 20 I_{NR} (minimum 0.1 A)
ACE990 - range 2 (0.00578 ≤ k ≤ 0.26316)	$I_{NR} = Ik.n$ (1)	0.01 to 20 I_{NR} (minimum 0.1 A)

(1) *n = number of zero sequence CT turns*
k = factor to be determined according to ACE990 wiring and setting range used by Sepam

Phase Voltage Inputs
Residual Voltage Input
Main Channels

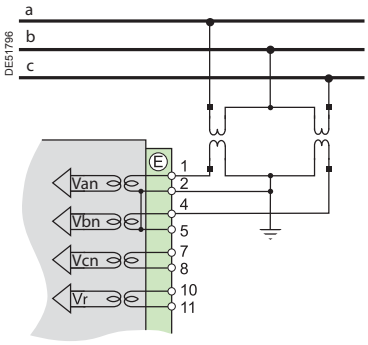
Phase Voltage Input Connection Cariants

Variant 1: Measuring three line-to-neutral voltages (3 V_{Ln}, standard connection)



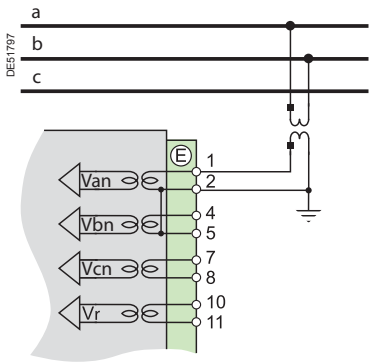
Measurement of the three line-to-neutral voltages allows the calculation of residual voltage, VrΣ

Variant 2: Measuring two line-to-line voltages (2 V_{LL})



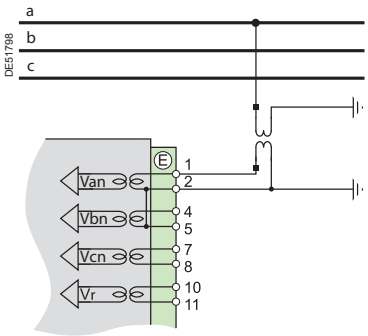
This variant does not allow the calculation of residual voltage

Variant 3: Measuring one line-to-line voltage (1 V_{LL})



This variant does not allow the calculation of residual voltage

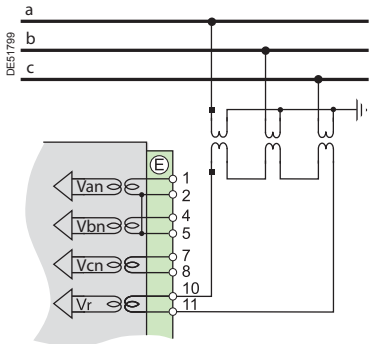
Variant 4: Measuring one line-to-neutral voltage (1 V_{Ln})



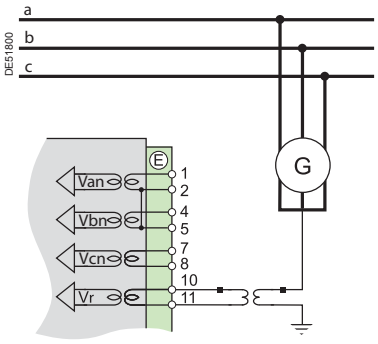
This variant does not allow the calculation of residual voltage

Residual Voltage Input Connection Variants

Variant 5: Measuring residual voltage Vr



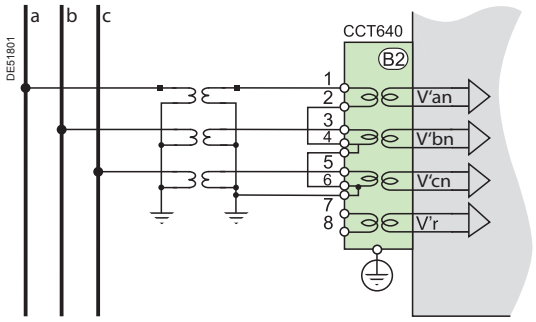
Variant 6: Measuring residual voltage $V_{Ln}t$ in generator neutral point



Phase Voltage Inputs
Residual Voltage Input
Additional Channels for Sepam B83

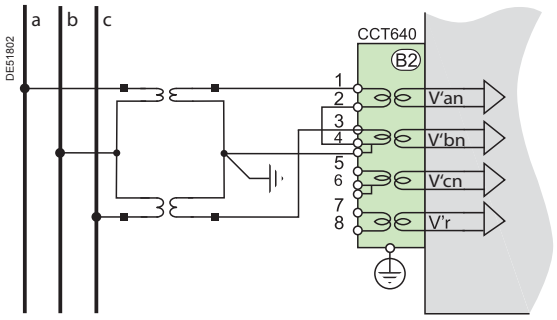
Additional Phase Voltage Input Connection Variants

Variant 1: Measuring three line-to-neutral voltages (3 V_{Ln}', standard connection)



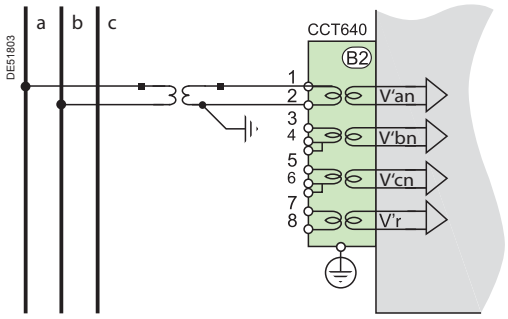
Measurement of the 3 line-to-neutral voltages allows the calculation of residual voltage, V'rΣ

Variant 2: Measuring two line-to-line voltages (2 V_{LL}')



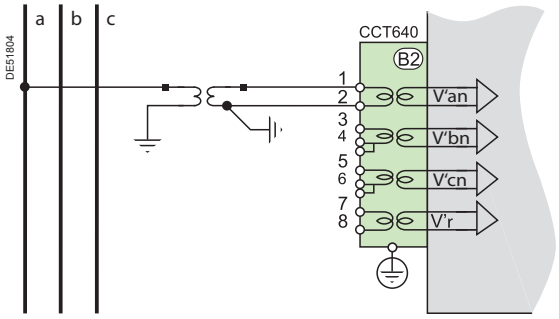
This variant does not allow for calculating residual voltage

Variant 3: Measuring one line-to-line voltage (1 V_{LL}')



This variant does not allow for calculating residual voltage.

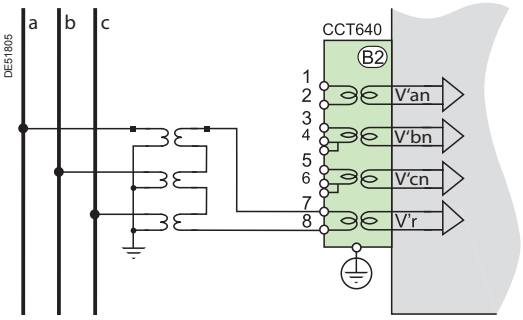
Variant 4: Measuring one line-to-neutral voltage (1 V_{Ln}')



This variant does not allow for calculating residual voltage.

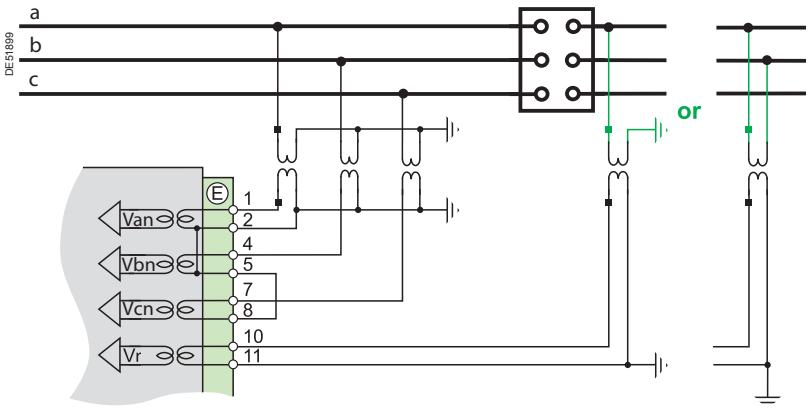
Additional Residual Voltage Input Connection

Variant 5: Measuring Residual Voltage V'r

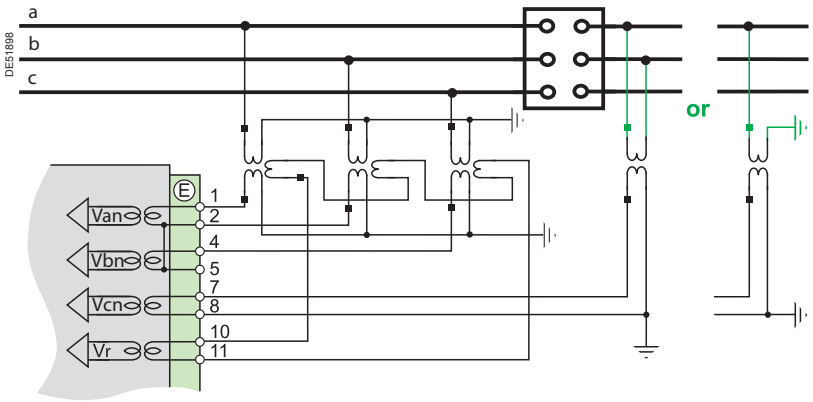


Phase Voltage Inputs
Residual Voltage Input
Additional Channel for Sepam B80

Connecting to Measure One Additional Voltage



This connection should be used to measure:
- three line-to-neutral voltages Van, Vbn, Vcn on bus number 1
- one additional line-to-neutral voltage V'an (or one additional line-to-line voltage V'ab) on bus number 2



This connection should be used to measure:
- two line-to-line voltages Vab, Vbc, and one residual voltage Vr on bus number 1
- one additional line-to-line voltage V'ab (or one additional line-to-neutral voltage V'an) on bus number 2.

Phase Voltage Inputs
Residual Voltage Input
Available Functions

The availability of certain protection and metering functions depends on the phase and residual voltages measured by Sepam. The table below gives the voltage input connection variants for which for each protection and metering function dependent on measured voltages is available. For example, the directional overcurrent protection function (ANSI 67N/67NC) uses residual voltage Vr as a polarization value. It is therefore operational in the following cases:

- measuring the three line-to-neutral voltages and calculating VrΣ (3 V + VrΣ, variant 1)
- measuring residual voltage Vr (variant 5).

The protection and metering functions which do not appear in the table below are available regardless of the voltages measured.

Phase Voltages Measured		**3 V + VrΣ**			**2 V_{LL}**			**1 V_{LL}**			**1 V_{Ln}**		
(Connection Variant)		**(var. 1)**			**(var. 2)**			**(var. 3)**			**(var. 4)**		
Residual Voltage Measured		**–**	**Vr**	**$V_{Ln}t$**	**–**	**Vr**	**$V_{Ln}t$**	**–**	**Vr**	**$V_{Ln}t$**	**–**	**Vr**	**$V_{Ln}t$**
(Connection Variant)			**(v. 5)**	**(v. 6)**		**(v. 5)**	**(v. 6)**		**(v. 5)**	**(v. 6)**		**(v. 5)**	**(v. 6)**
Protection Functions Dependent on Voltages Measured													
Directional phase overcurrent	67	■	■	■	■	■	■						
Directional ground fault	67N/67NC	■	■	■		■			■			■	
Directional active overpower	32P	■	■	■	■	■	■						
Directional reactive active overpower	32Q	■	■	■	■	■	■						
Directional active underpower	37P	■	■	■	■	■	■						
Field loss (underimpedance)	40	■	■	■	■	■	■						
Pole slip, phase shift	78PS	■	■	■	■	■	■						
Voltage-restrained overcurrent	50V/51V	■	■	■	■	■	■						
Underimpedance	21B	■	■	■	■	■	■						
Inadvertent energization	50/27	■	■	■	■	■	■						
100 % stator ground fault	64G2/27TN			■			■						
Overexcitation (V/Hz)	24	■	■	■	■	■	■	■	■	■	■	■	■
Positive sequence undervoltage	27D	■ □	■ □	■	■ □	■ □	■						
Remanent undervoltage	27R	■ □	■ □	■	■ □	■ □	■	■ □ ⊠	■ □	■	■ □ ⊠	■ □	■
Undervoltage ($_{LL}$ or $_{LN}$)	27	■ □	■ □	■	■ □	■ □	■	■ □ ⊠	■ □	■	■ □ ⊠	■ □	■
Overvoltage ($_{LL}$ or $_{LN}$)	59	■ □	■ □	■	■ □	■ □	■	■ □ ⊠	■ □	■	■ □ ⊠	■ □	■
Neutral voltage displacement	59N	■ □	■ □	■		■ □	■		■ □	■		■ □	■
Negative sequence overvoltage	47	■ □	■ □	■	■	■ □	■					■ □	
Overfrequency	81H	■ □	■ □	■	■ □	■ □	■	■ □ ⊠	■ □	■	■ □ ⊠	■ □	■
Underfrequency	81L	■ □	■ □	■	■ □	■ □	■	■ □ ⊠	■ □	■	■ □ ⊠	■ □	■
Rate of change of frequency	81R	■	■	■	■	■	■						
Measurements Dependent on Voltages Measured													
Line-to-line voltage Vab, Vbc, Vac or V'ab, V'bc, V'ac		■ □	■ □	■	■ □	■ □	■ □	Vab, V'ab	Vab	Vab			
Line-to-neutral voltage Van, Vbn, Vcn, or V'an, V'bn, V'cn		■ □	■ □	■		■					Van, V'an	Van, V'an	Van
Residual voltage Vr or V'r		■ □	■ □	■		■ □			■ □			■ □	
Neutral point voltage $V_{Ln}t$				■			■			■			■
Third harmonic neutral point or residual voltage				■			■			■			■
Positive sequence voltage V1 or V'1 / negative sequence voltage V2 or V'2		■ □	■ □	■	■ □	■ □	■						
Frequency		■ □	■ □	■ □	■ □	■ □	■ □	■ □ ⊠	■ □	■ □	■ □ ⊠	■ □	■ □
Active/reactive/apparent power: P, Q, S		■	■	■	■	■	■	■	■	■			
Maximum demand power Pmax, Qmax		■	■	■	■	■	■	■	■	■			
Active / reactive / apparent power per phase : Pa/Pb/Pc, Qa/Qb/Qc, Sa/Sb/Sc		■ (1)	■ (1)	■ (1)		■ (1)					Pa/ Qa/Sa	Pa/ Qa/Sa	Pa/ Qa/Sa
Power factor		■	■	■	■	■	■	■	■	■			
Calculated active and reactive energy (±Wh, ±VARh)		■	■	■	■	■	■	■	■	■			
Total harmonic distortion, voltage Vthd		■	■	■	■	■	■	■	■	■			
Phase displacement φr, φ'r		■	■	■		■			■			■	
Phase displacement φa, φb, φc		■	■	■	■	■	■						
Apparent positive sequence impedance Z1		■	■	■	■	■	■						
Apparent line-to-line impedances Zab, Zbv, Zac		■	■	■	■	■	■						

■ *Function available on main voltage channels.*
□ Function available on Sepam B83 additional voltage channels.
⊠ *Function available on Sepam B80 additional voltage channel, according to the type of the additional voltage measured.*
(1) *If all three phase currents are measured*

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Sepam Software

Presentation

Four types of Sepam PC software are available:
- SFT2841 setting and operating software
- SFT2826 disturbance recording data display software
- SFT2885 programming software for the Sepam Series 80 (Logipam)
- SFT850 advanced-configuration software for IEC 61850 protocol

SFT2841 and SFT2826 Software

SFT2841 and SFT2826 software is provided on the same CD-ROM as the Sepam documentation in PDF format.

PC Connection Cable

The CCA783 PC connection cable (ordered separately) is designed to connect a PC to the RS232 port on the front panel of a Sepam unit in order to use the SFT2841 software in point-to-point connected mode.

The USB/RS232 TSXCUSB232 converter may be used with the CCA783 connection cable for connection to a USB port.

SFT2885 Software

SFT2885 is available on a separate CD-ROM.

SFT850 Software

SFT850 is available on a separate CD-ROM

Minimum Configuration Required

SFT2841 and SFT2826 Software	
Operating systems	Microsoft 2000/XP
RAM	128 MB (32 MB for Windows 98)
Space on disk	120 MB

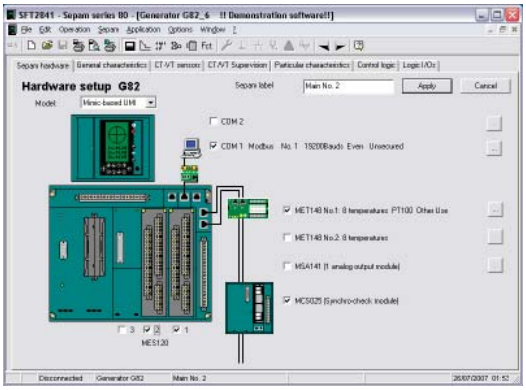
SFT2885	
Operating systems	Microsoft 2000/XP
RAM	64 MB
Space on disk	20 MB

SFT850	
Operating systems	Microsoft 2000/XP
RAM	64 MB
Space on disk	40 MB

SFT2841 Setting and Operating Software
Function

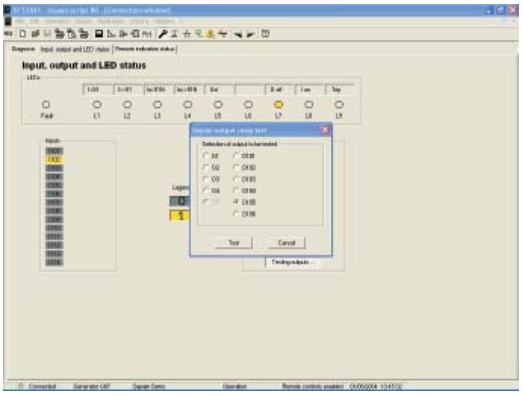
The SFT2841 software is the setting and operating tool for Sepam Series 20, Series 40, and Series 80.
It may be used:
- prior to commissioning and without connection to Sepam, to prepare Sepam protection and parameter settings
- during commissioning, on a PC connected point-to-point to the front panel Sepam:
  - to load, unload and modify Sepam protection and parameter settings
  - to obtain all measurements and useful information during commissioning
- during operation, on a PC connected to a set of Sepam relays via an E-LAN multipoint communication network:
  - to manage the protection system
  - to monitor the status of the electrical network
  - to run diagnostics on any incidents affecting the electrical network

PE50340



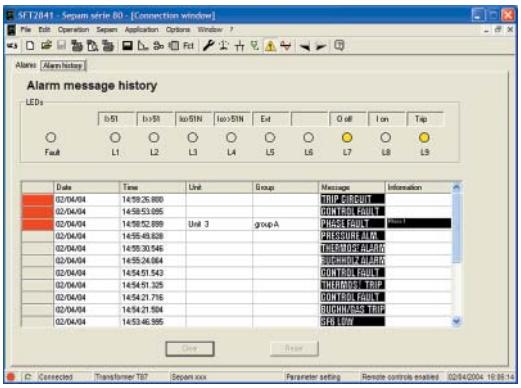
SFT2841: Sepam Series 80 hardware configuration.

PE50304



SFT2841: output testing.

PE50274



SFT2841: alarm history.

Preparation of Sepam Parameter and Protection Settings in Unconnected Mode
- configuration of Sepam and optional modules, and entry of general settings
- enabling/disabling of functions and entry of protection settings
- adaptation of predefined control and monitoring functions
- creation of personalized mimic diagrams for local display

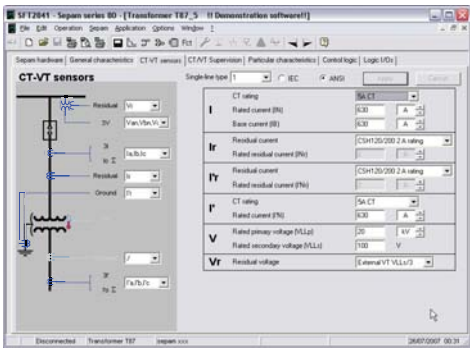
Sepam Commissioning via a Point-to-Point Connection to the Front Panel
- access to all functions available in unconnected mode, after entering the protection-setting or parameter-setting password
- transfer of Sepam parameter and protection setting file, prepared in unconnected mode (downloading function), protected by the parameter-setting password
- display of all measurements and useful information during commissioning
- display of logic input, logic output and LED status
- test of logic outputs
- display of Logipam variables
- setting of Logipam parameters (configuration bits, timers, etc.)
- modification of passwords

Management of Protection Functions and Network Diagnostics with an E-LAN Multipoint Network Connection
- reading all Sepam protection and parameter settings, with modifications following entry of the protection-setting or parameter-setting password
- display of all the Sepam measurement data
- display of Sepam, switchgear and network diagnosis data
- display of time-stamped alarm messages
- retrieval of disturbance recording data

Efficient, Easy-to-Use Software
- menus and icons for fast, direct access to the data required
- guided navigation to go through all the data input screens in the natural order
- all data on the same function together in the same screen
- trilingual software: English, French, Spanish
- on-line help, with all the technical information needed to use and implement Sepam
- familiar file management in Microsoft Windows environment:
  - all file management services included: copy / paste, save, etc.
  - printing parameter and protection settings in standard layout

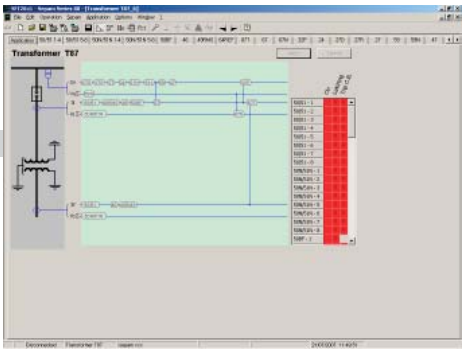
SFT2841 Setting and Operating Software
Function

PE50302



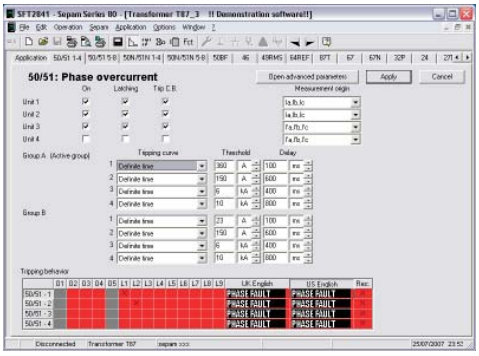
SFT2841: Sepam Series 80 sensor parameter setting.

PE50541



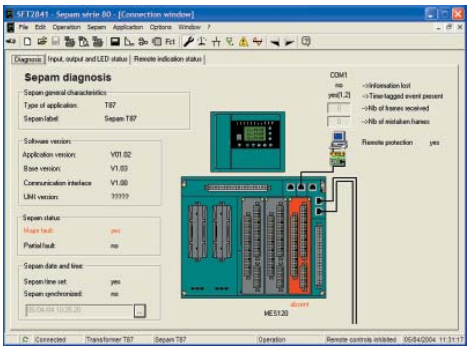
SFT2841: Sepam Series 80 application, with protection function measurement origin.

PE50275



SFT2841: protection settings.

PE50276



SFT2841: Sepam diagnosis.

The table below gives the SFT2841 functions available for the Sepam Series: Sepam Series 20, Series 40, and Series 80.

NC: *function available in unconnected mode.*

S: *function available with SFT2841 connected via Sepam front panel.*

E: *function available with SFT2841 connected to Sepam via E-LAN communication network.*

Functions	Series 20			Series 40			Series 80		
Management	**NC**	**S**	**E**	**NC**	**S**	**E**	**NC**	**S**	**E**
On-line help	■	■	■	■	■	■	■	■	■
Managing parameter and protection setting files: creation, saving, downloading and uploading	■	■	■	■	■	■	■	■	■
Downloading and uploading parameter and protection setting files		■	■		■	■ (1)		■	■
Exporting parameter and protection settings in a text file	■	■		■	■				
Printing parameter and protection settings	■	■	■	■	■	■	■	■	■
Modifying passwords, one for parameter setting and one for protection setting		■	■		■	■			
Sepam Parameter Setting									
Displaying parameter settings	■	■	■	■	■	■	■	■	■
Hardware configuration and parameter entry protected by parameter setting password	■	■	■	■	■	■	■	■	■
Graphical parameter setting assistance							■	■	■
Standard configuration for IEC 61850 network	■	■	■	■	■	■	■	■	■
Protection Setting									
Displaying protection settings	■	■	■	■	■	■	■	■	■
Entry of protection settings, protected by protection setting password	■	■	■	■	■	■	■	■	■
Defining customized tripping curve							■	■	■
Adapting Predefined Functions									
Display and modification of the control matrix	■	■	■	■	■	■	■	■	■
Logic equation editing					■	■	■	■	■
Number of instructions				100			200		
Number of dedicated remote indications				10			20		
Display of logic equations					■	■		■	■
Load the Logipam program							■	■	
Setting of Logipam parameters								■	■
Assignment of LEDs on front	■	■	■	■	■	■	■	■	■
Editing user messages					■	■		■	■
Number of user messages				30			100		
Editing of personalized mimic diagram							■	■	■
Assistance in Commissioning and Operating the Installation									
Display of all Sepam measurement data		■	■		■	■		■	■
Display of switchgear diagnosis assistance data		■	■		■	■		■	■
Display of machine operating assistance data		■	■		■	■		■	■
Display of time-stamped alarm messages		■	■		■	■		■	■
Tripping context		■	■		■	■		■	■
Retrieval of disturbance recording files		■	■		■	■		■	■
Display of Logipam variables		■	■		■	■		■	■
Display of logic input/output status		■	■		■	■		■	■
Output testing		■	■		■	■		■	■
Sepam diagnosis		■	■		■	■		■	■

***(1)** Except for logic equations and personalized messages.*

SFT2841 Setting and Operating Software
SFT2841 Connection to Sepam

SFT2841 Connection to the Front Panel of a Sepam

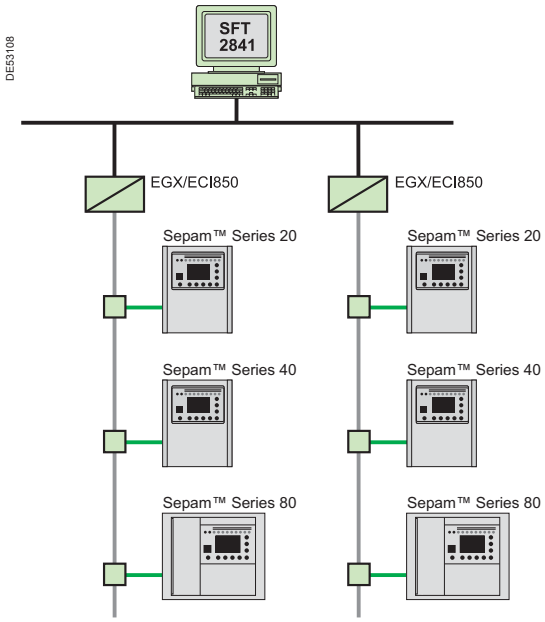
Connection of the PC RS232 serial port to the communication port on the front panel of Sepam Series 20, Series 40, or Series 80 using the CCA783 cable or the USB/RS232 (TSXCUSB232) converter + CCA783.

SFT2841 Connection to a Set of Sepam Relays

The SFT2841 can be connected to a set of Sepam relays, themselves connected to a E-LAN communication network in one of the three architectures presented below. These connections do not require any further software development work.

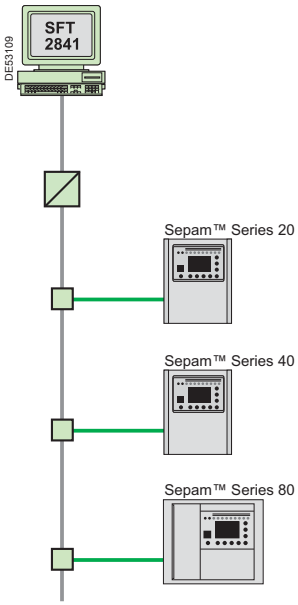
Ethernet Connection

- connection a set of Sepam to a Modbus RS485 network
- Ethernet RS485 link via the EGX100 or EGX400 gateway or the ECI850 server
- connection of the PC via its Ethernet port.



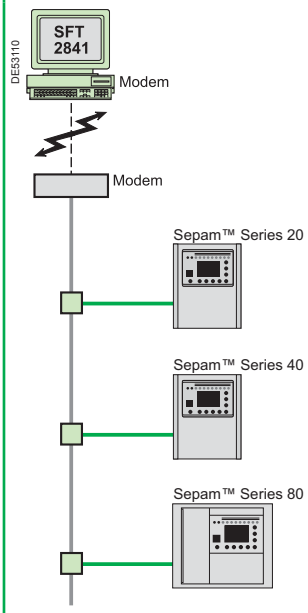
RS485 Serial Connection

- connection a set of Sepam to a Modbus RS485 network
- connection of the PC via its RS232 port, using the ACE9092 interface.



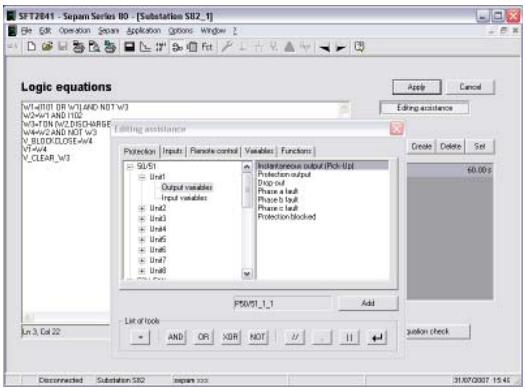
Telephone-Line Connection

- connection a set of Sepam to a Modbus RS485 network
- RS485-RTC link via an RS485 modem (Wertermo TD-34 for example)
- connection of the PC via its modem port.



SFT2841 Setting and Operating Software
Adapting the Predefined Functions

PE50277



SFT2841: logic equation editor.

Logic Equation Editor (Sepam Series 40 and Series 80)

The logic equation editor included in the SFT2841 software can be used to:

- complete protection function processing:
  - additional interlocking
  - conditional blocking/validation of functions
- adapt predefined control functions: particular circuit breaker or recloser control sequences

***Note:** the use of the logic equation editor excludes the possibility of using the Logipam programming software.*

A logic equation is created by grouping logic input data received from:

- protection functions
- logic inputs
- local control commands transmitted by the mimic-based UMI
- remote control commands

This grouping is accomplished by using the Boolean operators AND, OR, XOR, NOT, and automation functions such as time delays, bi-stables and time programmer. Equation input is assisted and syntax checking is done systematically.

The result of an equation may then be:

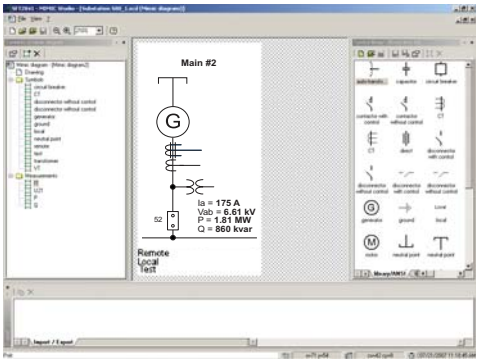
- assigned to a logic output, LED or message from the control matrix
- transmitted by the communication link, as a new remote indication
- utilized by the circuit breaker/contactor control function to trip, close or block breaking device closing
- used to block or reset a protection function

Alarms and Operating Messages (Sepam Series 40 and Series 80)

New alarm and operating messages may be created using the SFT2841 software. The new messages are added to the list of existing messages and may be assigned via the control matrix for display:

- on Sepam's advanced UMI
- in the SFT2841 "Alarms" and "Alarm History" screens

PE50542



SFT2841: mimic-diagram editor.

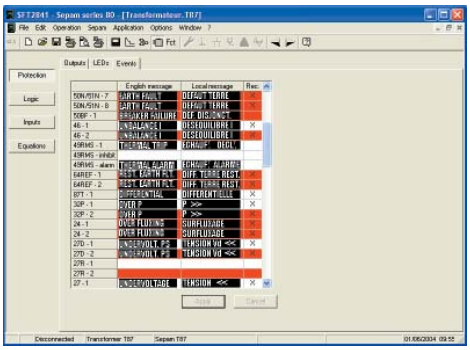
Local-Control Mimic Diagram (Sepam Series 80)

The local-control mimic diagram displayed on the UMI can be personalized by adapting one of the supplied, predefined mimic diagrams or by creating a diagram from scratch.

The mimic-diagram editor can be used to:

- create a fixed, bitmap background (128 x 240 pixels) using a standard drawing tool
- create animated symbols or use predefined animated symbols to represent the electrotechnical devices or other objects
- assign the logic inputs or internal status conditions that modify the animated symbols. For example, the logic inputs for the circuit-breaker position must be linked to the circuit-breaker symbol to enable the display of the open and closed conditions
- assign the logic outputs or internal status conditions that are activated when an opening or closing command are issued for the symbol
- display the current, voltage and power measurements on the mimic diagram

PE50305



SFT2841: control matrix.

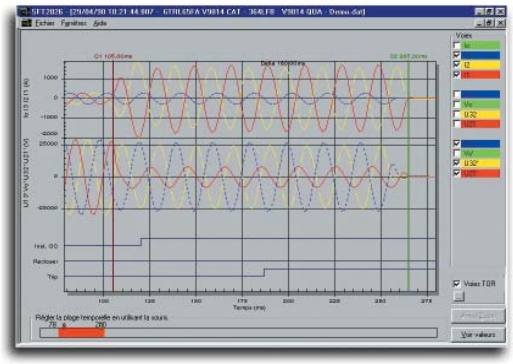
Control Matrix

The control matrix is used for simple assignment of data from:

- protection functions
- control and monitoring functions
- logic inputs
- logic equations or the Logipam program to the following output data:
  - logic outputs
  - 9 LEDs on the front of Sepam
  - messages for local display
  - triggering of disturbance recording

SFT2826 Disturbance Recording Data Display Software

M10623



SFT2826: analysis of a disturbance data record.

Function

The SFT2826 software is used to display, analyze, and print disturbance data recorded by Sepam. It uses COMTRADE (IEEE standard: Common format for transient data exchange for power systems) files.

Transferring Disturbance Recording Data

Before they are analyzed by SFT2826, the disturbance recording data must be transferred from Sepam to the PC:

- by the SFT2841 software
- or by the Modbus communication link

Analysis of Disturbance Recording Data

- selection of analog signals and logic data for display
- zoom and measurement of time between events
- display of all numerical values recorded
- exporting of data in file format
- printing of curves and/or numerical values recorded

Characteristics

The SFT2826 software comes with the SFT2841 software:

- four languages: English, French, Spanish, Italian
- on-line help with description of software functions

SFT850 Configuration Software for IEC 61850 Protocol

Function

The SFT850 software is used to easily create, modify and consult the SCL (Substation Configuration Language) configuration files for the IEC 61850 communication protocol:

- CID (Configured IED Description) file for configuration of a device connected to an IEC 61850 network
- SCD (Substation Configuration Description) file for IEC 61850 configuration of substation equipment.

The SFT850 software supplements the standard IEC 61850 configuration created with the SFT2841 software in cases where the configuration must be precisely adapted to system requirements.

Adding or Deleting Equipment

The SFT850 software can be used to add or delete connected equipment in the IEC 61850 configuration. If a Sepam unit is added, the software uses the supplied ICD (IED Capability Description) file to start configuration.

Equipment Connection

The SFT850 software describes the data for equipment connection to the network.

Editing the Equipment Configuration

The configuration of a given device described in a CID or SCD file can be modified in the following ways:

- add, modify or delete datasets. A dataset is used to group data and optimized communication
- add, modify or delete RCBs (Report Control Block). A Report Control Block defines dataset transmission conditions
- add, modify or delete GCBs (Goose Control Block). A Goose Control Block defines how data is exchanged between Sepam units
- modify dead measurement bands. This parameter is used to optimize communication in that measurements are transmitted only if they have changed significantly

Generating CID files

The SFT850 software can generate the CID file for each device on the basis of an SCD file.

SFT2885 Programming Software - Logipam

Function

The SFT2885 programming software (called Logipam) is a special option intended exclusively for the Sepam Series 80 and can be used to:

- adapt predefined control and monitoring functions
- program specific control and monitoring functions, either to replace the predefined versions or to create completely new functions, to provide all the functions required by the application.

It is made up of:

- a ladder-language program editor used to address all Sepam data and to program complex control functions
- a simulator for complete program debugging
- a code generator to run the program on Sepam

The ladder-language program and the data used can be documented and a complete file can be printed.

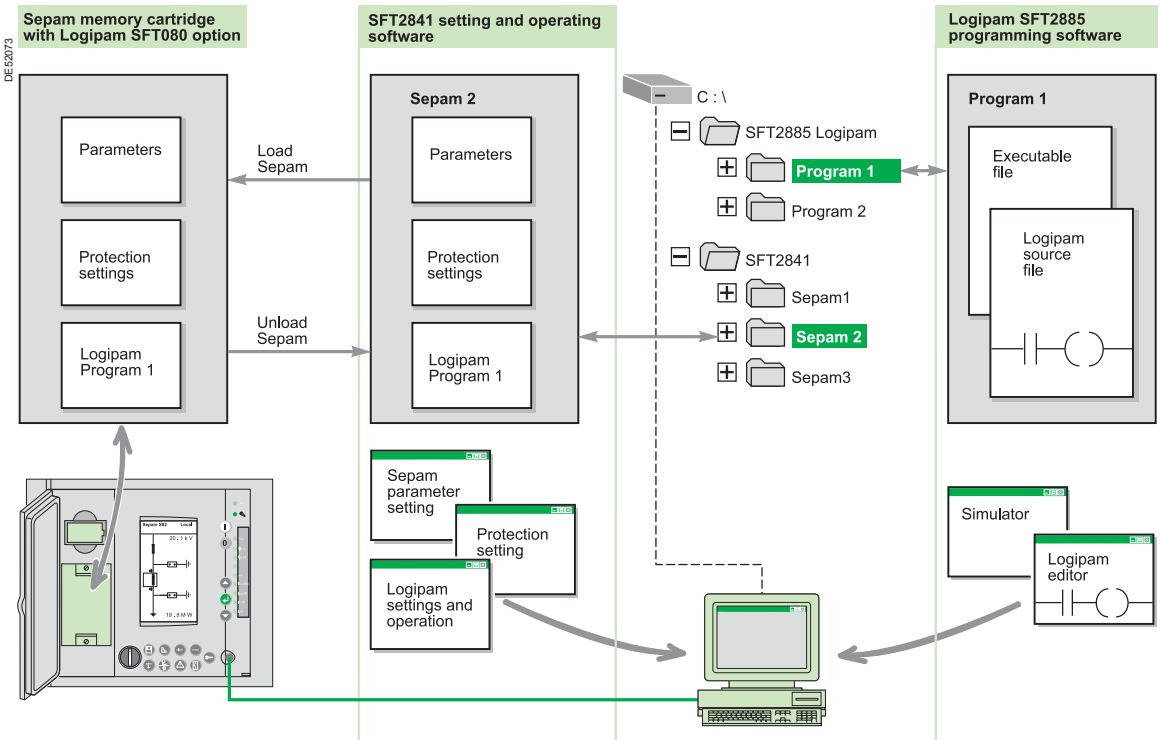
Only the Sepam Series 80 with a cartridge containing the Logipam SFT080 option can run the control and monitoring functions programmed by the Logipam SFT2885 software.

The complete Logipam software is made up of the executable program run by Sepam and the source program that can be modified by the Logipam SFT2885 programming software.

The SFT2841 setting and operating software, required for implementation of the Logipam program, offers the following functions:

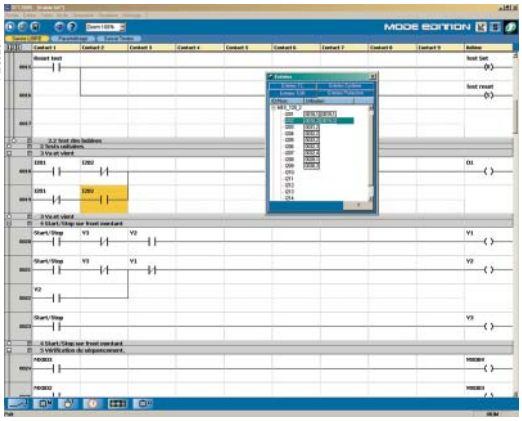
- association of the complete Logipam program with the Sepam parameter and protection settings
- loading and unloading of Logipam program, parameters and settings in the Sepam cartridge
- running functions programmed with Logipam:
  - display of the status of Logipam internal bits
  - setting Logipam parameters: configuration bits, timers

Operating Principle



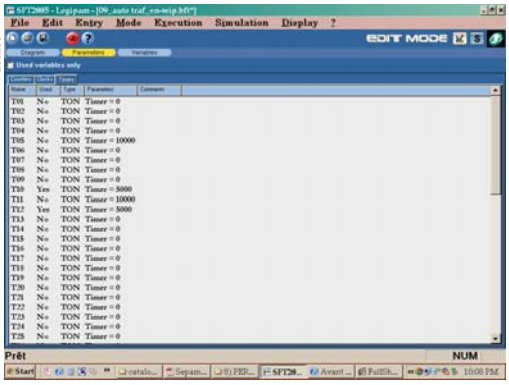
SFT2885 Programming Software - Logipam

PE50257



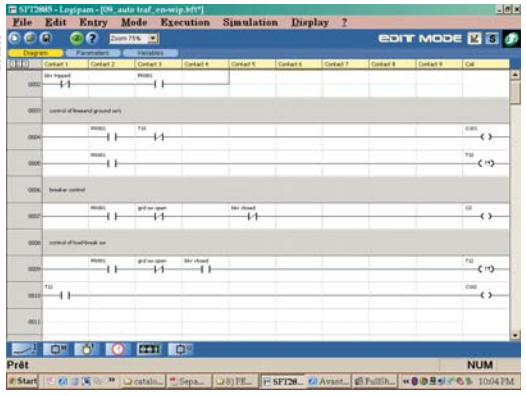
SFT2885: ladder-language program, structured in sections

PE50265



SFT2885: variable editor

PE50266



SFT2885: program debugging

Characteristics

Program Structure

A ladder-language program is made up of a series of rungs executed sequentially:
- maximum 1000 lines with 9 contacts and 1 coil maximum per line
- with a maximum total number of 5000 contacts and coils

Comments can be made for each line.

Sections

The program can be broken down into sections and subsections to clarify the structure and facilitate reading. It is possible to set up three levels of sections. Comments can be added for each section, and execution of each section can be subjected to conditions.

Variable Editor

Each variable is defined by a fixed identifier and can be linked to a name or a comment. The programmer can decide to work directly with the identifiers or with the linked names. The list of the variables used and the cross references can be consulted during programming.

Graphic Elements in the Ladder Language

The graphic elements are the instructions in the ladder language:
- NO and NC contacts
- rising and falling-edge detection contacts
- direct or negated coils
- set and reset coils
- coils and contacts linked to timers, counters and clocks

Available Resources

Sepam Variables

All the data used by Sepam functions can be addressed by Logipam:
- all logic inputs and outputs
- all remote-control commands and remote indications (the remote-control commands and remote indication used in the Logipam program are no longer used by the predefined functions)
- all protection-function inputs and outputs
- all inputs and outputs for the predefined control and monitoring functions
- all inputs and outputs for symbols in the mimic-based UMI
- all system data

Logipam Internal Variables
- 64 configuration bits to parameter program processing, settable via the SFT2841 software and the display
- 128 bits used by the control matrix to control LEDs, messages and logic outputs
- 128 internal bits that are saved
- 512 internal bits that are not saved

Logipam Functions
- 60 timers that can be set for a rising edge (TON) or a falling edge (TOF)
- 24 incremental counters with adjustable thresholds
- 4 clocks for a given week

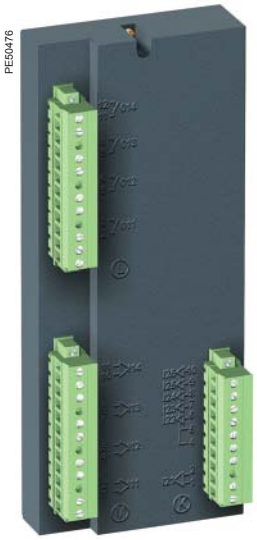
Debugging Tools

The Logipam software offers a complete set of tools for program debugging:
- step-by-step or continuous program execution to simulate the programmed functions
- color animation of the rungs and all program variables
- grouping in a table of all program variables requiring monitoring

Documentation

The application file can be printed in part or in whole. It can also be personalized with such items as a front page, title block, and general description of the program.

MES114 Modules



10 input/4 output MES114 module.

Function

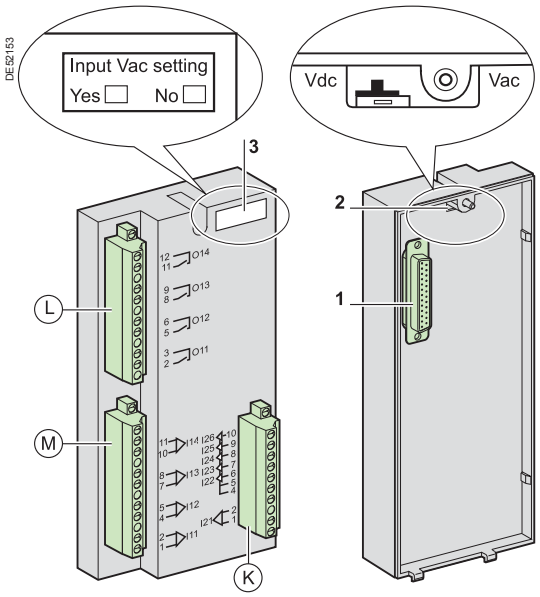
The four outputs included on the Sepam Series 20 and 40 may be extended by adding an optional MES114 module with 10 inputs and 4 outputs, available in three versions:

- MES114: 10 DC inputs voltage from 24 V DC to 250 V DC
- MES114E: 10 inputs, voltage 110-125 V AC or V DC
- MES114F: 10 inputs, voltage 220-250 V AC or V DC.

Characteristics

MES114 Module						
Weight	0.28 kg (0.617 lb)					
Operating temperature	-13 °F to +158 °F (-25 °C to +70 °C)					
Environmental characteristics	Same characteristics as Sepam base units					
Logical Inputs	**MES114**	**MES114E**		**MES114F**		
Voltage	24 to 250 V DC	110 to 125 V DC	110 V AC	220 to 250 V DC	220 to 240 V AC	
Range	19.2 to 275 V DC	88 to 150 VV DC	88 to 132 V AC	176 to 275 V DC	176 to 264 V AC	
Frequency	/	/	47 to 63 Hz	/	47 to 63 Hz	
Typical consumption	3 mA	3 mA	3 mA	3 mA	3 mA	
Typical switching threshold	14 V DC	82 V DC	58 V AC	154 V DC	120 V AC	
Input limit voltage — At state 0	≥ 19 V DC	≥ 88 V DC	≥ 88 V AC	≥ 176 V DC	≥ 176 V AC	
Input limit voltage — At state 1	≤ 6 V DC	≤ 75 V DC	≤ 22 V AC	≤ 137 V DC	≤≥ 48 V AC	
Isolation of inputs from other isolated groups	Enhanced	Enhanced	Enhanced	Enhanced	Enhanced	
Isolation between inputs	Enhanced	Enhanced	Enhanced	Enhanced	Enhanced	
O11 Control Relay Output						
Voltage	DC	24 / 48 V DC	127 V DC	220 V DC	250 V CC	
	AC (47.5 to 63 Hz)	-	-	-	-	100 to 240 V AC
Continuous current		8 A	8 A	8 A	8 A	8 A
Breaking capacity	Resistive load	8 / 4 A	0.7 A	0.3 A	0.2 A	8 A
	Load L/R < 20 ms	6 / 2 A	0.5 A	0.2 A	-	-
	Load L/R < 40 ms	4 / 1 A	0.2 A	0.1 A	-	-
	Load cos j > 0.3	-	-	-	-	5 A
Making capacity		< 15 A for 200 ms				
Isolation of outputs from other isolated groups	Enhanced					
Isolation between outputs	Enhanced					
O12 to O14 Indication Relay Output						
Voltage	DC	24 / 48 V DC	127 V DC	220 V DC	250 V DC	
	AC (47.5 to 63 Hz)	-	-	-	-	100 to 240 V AC
Continuous current		2 A	2 A	2 A	2 A	2 A
Breaking capacity	Resistive load	2 / 1 A	0.6 A	0.3 A	0.2 A	-
	Load L/R < 20 ms	2 / 1 A	0.5 A	0.15 A	-	-
	Load cos j > 0.3	-	-	-	-	1 A
Making capacity		< 15 A for 200 ms				
Isolation of outputs in relation to other isolated groups	Enhanced					
Isolation between outputs	Enhanced					

MES114 Modules



Description

Ⓛ, Ⓜ and Ⓚ : 3 removable, lockable screw-type connectors
Ⓛ : connectors for 4 relay outputs:
- O11: 1 control relay output
- O12 to O14: 3 annunciation relay outputs

Ⓜ : connectors for 4 independent logic inputs I11 to I14
Ⓚ : connectors for 6 logic inputs:
- I21: 1 independent logic input
- I22 to I26: 5 common point logic inputs.

1 25-pin sub-D connector to connect the module to the base unit.
2 Voltage selector switch for MES114E and MES114F module inputs, to be set to:
- V DC for 10 DC voltage inputs (default setting)
- V AC for 10 AC voltage inputs.

3 Label to be filled in to indicate the chosen parameter setting for MES114E and MES114F input voltages.

The parameter setting status can be accessed in the “Sepam Diagnosis” screen of the SFT2841 software tool. Parameter setting of the inputs for AC voltage (V AC setting) blocks the “operating time measurement” function.

Assembly

1. Insert the 2 pins on the MES module into the slots **1** on the base unit.
2. Flatten the module up against the base unit to plug it into the connector **2.**
3. Tighten the mounting screw **3.**

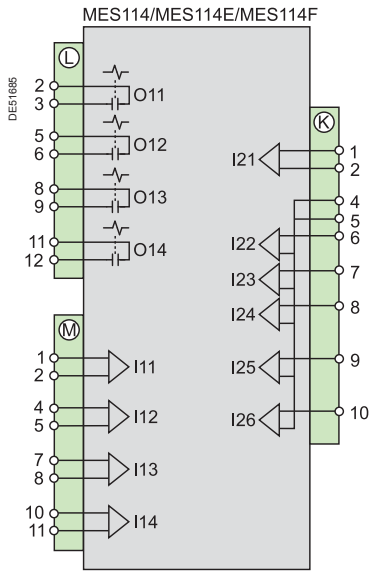
Connection

The inputs are potential-free and the DC power supply source is external.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH
- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding
- Always use a properly rated voltage sensing device to confirm that all power is off
- Screw tight all terminals, even those not in use

Failure to follow these instructions will result in death or serious injury.



Wiring for connectors Ⓛ, Ⓜ and Ⓚ :
- Wiring with no fittings:
  - 1 wire with maximum cross-section ≥ AWG 24-12 (0.2 to 2.5 mm²)
  - or 2 wires with maximum cross-section ≥ AWG 24-18 (0.2 to 1 mm²)
  - stripped length: 0.315 to 0.39 in (8 to 10 mm)
- Wiring with fittings:
  - terminal 5, recommended wiring with Telemecanique fitting:
    - DZ5CE015D for 1 wire 1.5 mm² (AWG 16)
    - DZ5CE025D for 1 wire 2.5 mm² (AWG 12)
    - AZ5DE010D for 2 wires 1 mm² (AWG 18)
  - wire length: 0.32 in (8.2 mm)
  - stripped length: 0.31 in (8 mm)

Logic Input/Output Assignment of Sepam Series 20

Using preset control and monitoring functions requires exclusive parameter setting and particular wiring of the inputs according to their application and the type of Sepam. The advanced UMI or the SFT2841 software may be used to assign inputs and set the control and monitoring function parameters.

Since an input may only be assigned to a single function, not all the functions are available at the same time. For example, if the zone selective interlocking function is used, the switching of groups of settings function can not be used.

Input/Output Assignment by Application

Functions	S20	S23	T20	T23	M20	B21 - B22	Assignment
Logic Inputs							
Open position	■	■	■	■	■	■	I11
Closed position	■	■	■	■	■	■	I12
Zone selective interlocking, receive blocking input	■	■	■	■			I13
Switching groups of settings A/B	■	■	■	■	■		
External reset	■	■	■	■	■	■	I14
External tripping 4 (1)	■	■	■	■	■	■	
External tripping 1 (1)	■	■	■ (2)	■ (2)	■	■	I21
External network synchronization	■	■	■	■	■	■	
External tripping 2 (1)	■	■	■ (3)	■ (3)	■	■	I22
Motor re-acceleration					■		
External tripping 3 (1)	■	■	■ (4)	■ (4)	■	■	I23
Buchholz alarm (1) (Buchholz alarm message)			■	■			
Rotor rotation detection					■		
Thermistor tripping (1)			■	■	■		
Block ground fault protection		■					
End of charging position	■	■	■	■	■		I24
Thermostat alarm (1) (thermostat alarm message)			■	■			
Thermistor alarm (1)			■	■	■		
External tripping 5 and 50BF activation (1)		■		■			
Block remote control, excluding TC1 (1)	■	■	■	■	■	■	I25
Block remote control, including TC1 (1)	■	■	■	■	■	■	
SF6-1	■	■	■	■	■	■	
SF6-2	■	■	■	■	■	■	I26
Change of thermal settings			■	■	■		
Block thermal overload			■	■	■		
Block recloser	■	■					
Logic Outputs							
Tripping	■	■	■	■	■	■	O1
Block closing	■	■	■	■	■	■	O2
Watchdog	■	■	■	■	■	■	O4
Close command	■	■	■	■	■	■	O11

Note: *all of the logic inputs are available via the communication link and are accessible in the SFT2841 control matrix for other non predefined applications.*

(1) *These inputs have parameter setting with the prefix "NEG" (negative) for undervoltage type operation.*
(2) *Buchholz/Gas trip message.*
(3) *Thermostat trip message.*
(4) *Pressure trip message.*

Logic Input/Output Assignment of Sepam Series 40

Inputs and outputs may be assigned to predefined control and monitoring functions using the SFT2841 software, according to the uses listed in the table below.

- all the logic inputs, whether or not assigned to predefined functions, may be used for the SFT2841 customization functions according to specific application needs:
  - in the control matrix, to link inputs to output relays, LED indications or display messages
  - in the logic equation editor, as logic equation variables
- the control logic of each input may be inverted for undervoltage type operation.

Assignment: Logic Inputs by Application

Functions	S40, S41	S42	T40, T42	M41	G40	Assignment
Logic Inputs						
Open position	■	■	■	■	■	I11
Closed position	■	■	■	■	■	I12
Zone selective interlocking, receive blocking input 1	■	■	■		■	Free
Zone selective interlocking, receive blocking input 2		■				Free
Switching of groups of settings A/B	■	■	■	■	■	I13
External reset	■	■	■	■	■	Free
External tripping 1	■	■	■	■	■	Free
External tripping 2	■	■	■	■	■	Free
External tripping 3	■	■	■	■	■	Free
Buchholz/gas tripping			■			Free
Thermostat tripping			■			Free
Pressure tripping			■			Free
Thermistor tripping			■	■	■	Free
Buchholz/gas alarm			■			Free
Thermostat alarm			■			Free
Pressure alarm			■			Free
Thermistor alarm			■	■	■	Free
End of charging position	■	■	■	■	■	Free
Block remote control	■	■	■	■	■	Free
SF6	■	■	■	■	■	Free
Block recloser	■	■				Free
External synchronization	■	■	■	■	■	I21
Block thermal overload			■	■	■	Free
Switching of thermal settings			■	■	■	Free
Motor re-acceleration				■		Free
Rotor rotation detection				■		Free
Block undercurrent				■		Free
Block closing	■	■	■	■	■	Free
Open command	■	■	■	■	■	Free
Close command	■	■	■	■	■	Free
Phase voltage transformer fuse melting	■	■	■	■	■	Free
Residual voltage transformer fuse melting	■	■	■	■	■	Free
External positive active energy counter	■	■	■	■	■	Free
External negative active energy counter	■	■	■	■	■	Free
External positive reactive energy counter	■	■	■	■	■	Free
External negative reactive energy counter	■	■	■	■	■	Free
Logic Outputs						
Tripping	■	■	■	■	■	O1
Block closing	■	■	■	■	■	O2
Watchdog	■	■	■	■	■	O4
Close command	■	■	■	■	■	O11

Note: *The logic inputs are available via the communication link and are accessible in the SFT2841 matrix for other non predefined applications.*

MES120, MES120G, MES120H 14 Input/6 Output Module

Presentation

MES120 14 input / 6 output module.

Function

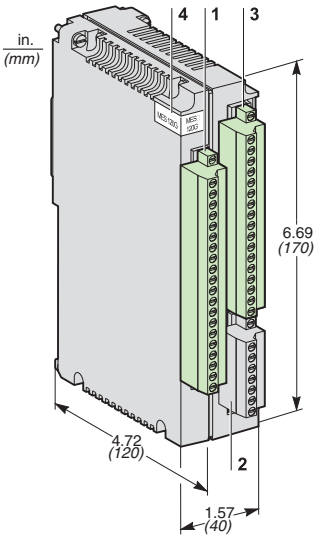
The five output relays included on the Sepam Series 80 base unit can be extended by adding one, two, or three MES120 modules with 14 DC logic inputs and 6 outputs relays, 1 control relay output and 5 indication relay outputs.

Two modules are available for the different input supply voltage ranges and offer different switching thresholds:

- MES120, 14 inputs 24 V DC to 250 V DC with a typical switching threshold of 14 V DC
- MES120G, 14 inputs 220 V DC to 250 V DC with a typical switching threshold of 155 V DC
- MES120H, 14 inputs 110 V DC to 125 V DC with a typical switching threshold of 82 V DC.

Characteristics

MES120 / MES120G / MES120H Modules						
Weight		0,38 kg (0,83 lb)				
Operating temperature		-25 °C to +70 °C (-13 °F to +158 °F)				
Environmental characteristics		Same characteristics as Sepam base units				
Logic Inputs		**MES120**	**MES120G**	**MES120H**		
Voltage		24 à 250 V DC	220 to 250 V DC	110 to 125 V DC		
Range		19.2 à 275 V DC	170 to 275 V DC	88 to 150 V DC		
Typical consumption		3 mA	3 mA	3 mA		
Typical switching threshold		14 V DC	155 V DC	82 V DC		
Input limit voltage	At state 0	< 6 V DC	< 144 V DC	< 75 V DC		
	At state 1	> 19 V DC	> 170 V DC	> 88 V DC		
Isolation of inputs from other isolated groups		Enhanced	Enhanced	Enhanced		
Control Relay Output Ox01						
Voltage	DC	24/48 V DC	127 V DC	220 V DC	250 V DC	
	AC (47.5 to 63 Hz)	-	-	-	-	100 à 240 V AC
Continuous current		8 A	8 A	8 A	8 A	8 A
Breaking capacity	Resistive load	8 / 4 A	0.7 A	0.3 A	0.2 A	8 A
	Load L/R < 20 ms	6 / 2 A	0.5 A	0.2 A	-	-
	Load L/R < 40 ms	4 / 1 A	0.2 A	0.1 A	-	-
	Load p.f > 0.3	-	-	-	-	5 A
Making capacity		< 15 A for 200 ms				
Isolation of inputs from other isolated groups		Enhanced				
Annunciation Relay Input Ox02 to Ox06						
Tension	Continue	24/48 V DC	127 V DC	220 V DC	250 V DC	
	Alternative (47.5 à 63 Hz)	-	-	-	-	100 to 240 V AC
Continuous current		2 A	2 A	2 A	2 A	2 A
Breaking capacity	Load L/R < 20 ms	2 / 1 A	0.5 A	0.15 A	0.2 A	-
	Load p.f > 0.3	-	-	-	-	1 A
Isolation of inputs from other isolated groups		Enhanced				



Description

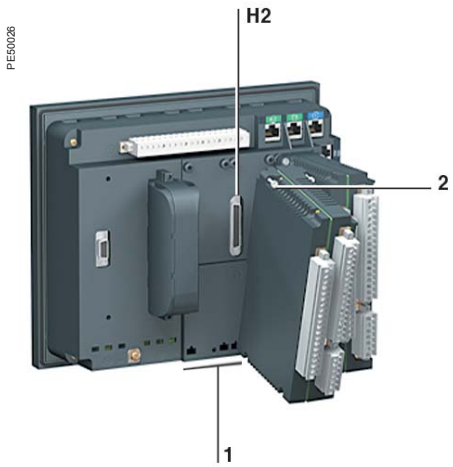
3 removable, lockable screw-type connectors.
1 20-pin connector for 9 logic inputs:
- **Ix01 to Ix04: 4 independent logic inputs**
- **Ix05 to Ix09: 5 common point logic inputs.**

2 7-pin connector for 5 common point logic inputs Ix10 à Ix14.
3 17-pin connector for 6 relay outputs:
- **Ox01: 1 control relay output**
- **Ox02 to Ox06 : 5 indication relay outputs.**

Addressing of MES120 module inputs / outputs:
- **x = 1 for the module connected to H1**
- **x = 2 for the module connected to H2**
- **x = 3 for the module connected to H3.**

4 MES120G, MES120H identification label (MES120 modules have no labels).

MES120, MES120G, MES120H
14 Input/6 Output Module
Installation



Installation of the second MES120 module, connected to base unit connector H2.

Assembly

Installing an MES120 Module on the Base Unit

- insert the two pins on the MES module into the slots **(1)** on the base unit
- push the module flat up against the base unit to plug it into the connector **H2**
- partially tighten the two mounting screws **(2)** before locking them.

MES120 modules must be mounted in the following order:

- if only one module is required, connect it to connector **(H1)**
- if two modules are required, connect them to connectors **(H1)** and **(H2)**
- if three modules are required (maximum configuration), the three connectors **(H1, H2,** and **H3)** are used.

Connection

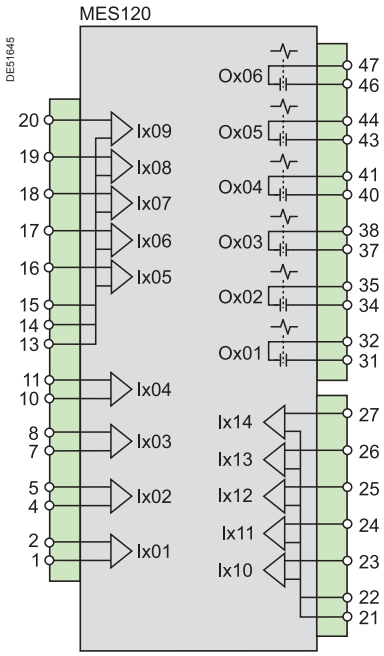
The inputs are potential-free and the DC power supply source is external.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device.
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Screw tight all terminals, even those not in use.

Failure to follow these instructions will result in death or serious injury.



Wiring Connectors

- wiring without fittings:
  - 1 wire with maximum cross-section ≥ AWG 24-12 (0.2 to 2.5 mm²)
  - or 2 wires with maximum cross-section ≥ AWG 24-16 (0.2 to 1 mm²)
  - stripped length: 0.31 to 0.39 in (8 to 10 mm)
- wiring with fittings:
  - recommended wiring with Telemecanique fittings:
    - DZ5CE015D for one AWG 16 (1.5 mm²) wire
    - DZ5CE025D for one AWG 12 (2.5 mm²) wire
    - AZ5DE010D for two AWG 18 (1 mm²) wires
  - wire length: 0.32 in (8.2 mm)
  - stripped length: 0.31 in (8 mm).

MES120, MES120G, MES120H
14 Input/6 Output Module
Logic Input/Output Assignment

Inputs and outputs may be assigned to predefined control and monitoring functions using the SFT2841 software, according to the uses listed in the table below. The control logic of each input may be inverted for undervoltage type operation. All the logic inputs, whether or not assigned to predefined functions, may be used for the customization functions according to specific application needs:

- in the control matrix (SFT2841 software), to connect an input to a logic output, a LED on the front of Sepam or a message for local indication on the display
- in the logic equation editor (SFT2841 software), as logic equation variables
- in Logipam (SFT2885 software) as input variables for the program in ladder language

Logic Output Assignment Table

Functions	S80	S81	S82	S84	T81	T82 T87	M87	M81 M88	G87	G82 G88	B80	B83	C86	Assignment
Tripping / contactor control	■	■	■	■	■	■	■	■	■	■	■	■	■	O1
Block closing	■	■	■	■	■	■	■	■	■	■	■	■	■	O2 by default
Closing	■	■	■	■	■	■	■	■	■	■	■	■	■	O3 by default
Watchdog	■	■	■	■	■	■	■	■	■	■	■	■	■	O5
Zone selective interlocking, blocking send 1	■	■	■	■	■	■	■	■	■	■	■	■	■	O102 by default
Zone selective interlocking, blocking send 2			■	■		■			■	■				O103 by default
Genset shutdown									■	■				Free
De-excitation									■	■				Free
Load shedding							■	■						Free
AT, closing of NO circuit breaker	■	■	■	■	■	■			■	■	■	■		Free
AT, closing of tie breaker	■	■	■	■	■	■			■	■	■	■		Free
AT, opening of tie breaker	■	■	■	■	■	■			■	■	■	b		Free
Tripping of capacitor step (1 to 4)													■	Free
Tripping of capacitor step (1 to 4)													■	Free

Note: *The logic outputs assigned by default may be freely reassigned.*

Assignment Table for Logic Inputs Common to all Applications

Functions	S80	S81	S82	S84	T81	T82 T87	M87	M81 M88	G87	G82 G88	B80	B83	C86	Assignment
Closed circuit breaker	■	■	■	■	■	■	■	■	■	■	■	■	■	I101
Open circuit breaker	■	■	■	■	■	■	■	■	■	■	■	■	■	I102
Synchronization of Sepam internal clock via external pulse	■	■	■	■	■	■	■	■	■	■	■	■	■	I103
Switching of groups of settings A/B	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
External reset	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
Grounding switch closed	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
Grounding switch open	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
External trip 1	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
External trip 2	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
External trip 3	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
End of charging position	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
Block remote control (Local)	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
SF6 pressure default	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
Block closing	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
Open command	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
Close command	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
Phase VT fuse blown	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
Vr VT fuse blown	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
External positive active energy meter	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
External negative active energy meter	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
External positive reactive energy meter	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
External negative reactive energy meter	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
Racked out circuit breaker	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
Switch A closed	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
Switch A open	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
Switch B closed	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
Switch B open	■	■	■	■	■	■	■	■	■	■	■	■	■	Free
Closing-coil monitoring	■	■	■	■	■	■	■	■	■	■	■	■	■	Free

MES120, MES120G, MES120H 14 Input/6 Output Module

Logic Input/Output Assignment

Assignment of Logic Inputs by Application

Functions	S80	S81	S82	S84	T81	T82 T87	M87	M81 M88	G87	G82 G88	B80	B83	C86	Assignment
Block recloser	■	■	■	■										Free
Block thermal overload		■	■	■	■	■	■	■	■	■			■	Free
Switching of thermal settings					■	■	■	■	■	■				Free
Blocking reception 1	■	■	■	■	■	■			■	■	■	■		Free
Blocking reception 2			■	■		■			■	■				Free
Buchholz trip					■	■		■		■				Free
Thermostat trip					■	■		■		■				Free
Pressure trip					■	■		■		■				Free
Thermistor trip					■	■	■	■	■	■				Free
Buchholz alarm					■	■		■		■				Free
Thermostat alarm					■	■		■		■				Free
Pressure alarm					■	■		■		■				Free
Thermistor alarm					■	■	■	■	■	■				Free
Rotor speed measurement							■	■	■	■				I104
Rotor rotation detection							■	■						Free
Motor re-acceleration							■	■						Free
Load shedding request							■	■						Free
Block undercurrent							■	■						Free
Priority genset shutdown									■	■				Free
De-excitation									■	■				Free
Close enable (ANSI 25)	■	■	■	■	■	■			■	■	■	■		Free
Block opposite-side remote control (local)	■	■	■	■	■	■			■	■	■	■		Free
Block remote-control tie breaker (local)	■	■	■	■	■	■			■	■	■	■		Free
Tie breaker open	■	■	■	■	■	■			■	■	■	■		Free
Tie breaker closed	■	■	■	■	■	■			■	■	■	■		Free
Opposite side open	■	■	■	■	■	■			■	■	■	■		Free
Opposite side closed	■	■	■	■	■	■			■	■	■	■		Free
Selector set to Manual (ANSI 43)	■	■	■	■	■	■			■	■	■	■		Free
Selector set to Auto (ANSI 43)	■	■	■	■	■	■			■	■	■	■		Free
Selector set to Circuit breaker (ANSI 10)	■	■	■	■	■	■			■	■	■	■		Free
Selector set to Tie Breaker (ANSI 10)	■	■	■	■	■	■			■	■	■	■		Free
Opposite-side circuit breaker disconnected	■	■	■	■	■	■			■	■	■	■		Free
Tie breaker circuit breaker disconnected	■	■	■	■	■	■			■	■	■	■		Free
Tie breaker close command	■	■	■	■	■	■			■	■	■	■		Free
Opposite-side voltage OK	■	■	■	■	■	■			■	■	■	■		Free
Block closing of tie breaker	■	■	■	■	■	■			■	■	■	■		Free
Automatic closing command	■	■	■	■	■	■			■	■	■	■		Free
External closing command 1											■	■		Free
External closing command 2											■	■		Free
Additional phase voltage transformer fuse blown											■	■		Free
Additional Vr voltage transformer fuse blown												■		Free
Capacitor step 1 open													■	Free
Capacitor step 1 closed													■	Free
Capacitor step 2 open													■	Free
Capacitor step 2 closed													■	Free
Capacitor step 3 open													■	Free
Capacitor step 3 closed													■	Free
Capacitor step 4 open													■	Free
Capacitor step 4 closed													■	Free
Step 1 opening command													■	Free
Step 2 opening command													■	Free
Step 3 opening command													■	Free
Step 4 opening command													■	Free
Step 1 closing command													■	Free
Step 2 closing command													■	Free
Step 3 closing command													■	Free
Step 4 closing command													■	Free
Step 1 external trip													■	Free
Step 2 external trip													■	Free
Step 3 external trip													■	Free
Step 4 external trip													■	Free
Capacitor step 1 VAR control													■	Free
Capacitor step 2 VAR control													■	Free
Capacitor step 3 VAR control													■	Free
Capacitor step 4 VAR control													■	Free
External capacitor step control block													■	Free
Manual capacitor step control													■	Free
Automatic capacitor step control													■	Free

Selection Guide and Connection

Selection Guide

Four remote modules are proposed as options to enhance the Sepam base unit functions:

- the number and type of remote modules compatible with the base unit depend on the Sepam application
- the DSM303 remote advanced UMI module is only compatible with base units that do not have integrated advanced UMIs

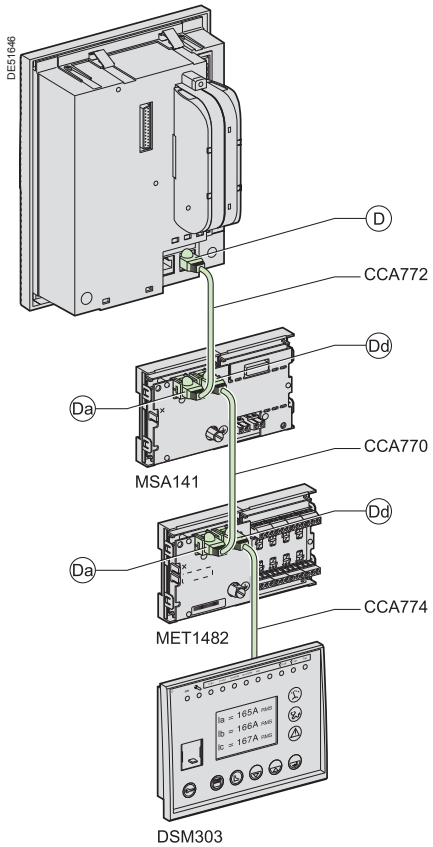
			Sepam Series 20		Sepam Series 40		Sepam Series 80		
			S2x, B2x	T2x, M2x	S4x	T4x, M4x, G4x	S8x, B8x	T8x, G8x	M8x, C8x
MET1482	Temperature sensor module	See page 149	0	1	0	2	0	2	2
MSA141	Analog output module	See page 151	1	1	1	1	1	1	1
DSM303	Remote advanced UMI module	See page 152	1	1	1	1	1	1	1
MCS025	Synchro-check module	See page 154	0	0	0	0	1	1	0
Number of sets of interlinked modules / maximum number of remote modules			1 set of 3 interlinked modules		1 set of 3 interlinked modules		5 modules split between 2 sets of interlinked modules		

CAUTION

HAZARD OF NON-OPERATION

The MCS025 module must ALWAYS be connected with the special CCA785 cable that is supplied with the module and equipped with an orange RJ45 plug and a black RJ45 plug.

Failure to follow this instruction can cause equipment damage.



Example of inter-module linking on Sepam Series 20

Connection

Connection Cables

Different combinations of modules may be connected using cables fitted with two black RJ45 connectors, which come in three lengths:

- CCA770: length = 2 ft (0.6 m)
- CCA772: length = 6.6 ft (2 m)
- CCA774: length = 13.1 ft (4 m)

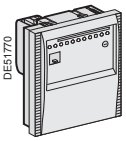
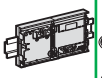
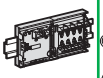
The modules are linked by cables which provide the power supply and act as functional links with the Sepam unit (connector (D) to connector (Da), (Dd) to (Da), …).

Rules on Inter-Module Linking

- Link three modules maximum
- DSM303 and MCS025 modules may only be connected at the end of the link

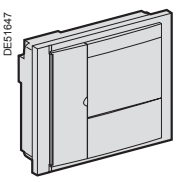
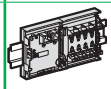
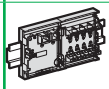
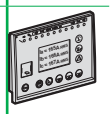
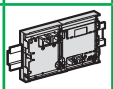
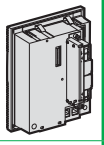
Maximum Advisable Configurations

Sepam Series 20 and Sepam Series 40 with One set of Interlinked Modules

Base	Cable	Module 1	Cable	Module 2	Cable	Module 3
						
Series 20	CCA772	MSA141	CCA770	MET1482	CCA774	DSM303
Series 40	CCA772	MSA141	CCA770	MET1482	CCA774	DSM303
Series 40	CCA772	MSA141	CCA770	MET1482	CCA772	MET1482
Series 40	CCA772	MET1482	CCA770	MET1482	CCA774	DSM303

Sepam Series 80 with Two sets of Interlinked Modules

Sepam Series 80 has 2 connection ports for remote modules, (D1) and (D2). Modules may be connected to either port.

Base	Cable	Module 1	Cable	Module 2	Cable	Module 3
Set 1 (D1)	CCA772	MET1482	CCA770	MET1482	CCA774	DSM303
						
					-	-
Set 2 (D2)	CCA772	MSA141	CCA785	MCS025	-	-

MET1482 Temperature Sensor Module

PE50021

MET1482 Temperature sensor module.

Function

The MET1482 module can be used to connect eight temperature sensors (RTDs) of the same type:

- Pt100, Ni100 or Ni120 type RTDs, according to parameter setting
- 3-wire temperature sensors
- A single module for each Sepam Series 20 base unit, connected by a CCA770 (2 ft or 0.6 m), CCA772 (6.6 ft or 2 m) or CCA774 (13.1 ft or 4 m) cable
- two modules for each Sepam Series 40 or Series 80 base units, connected by a CCA770 (2 ft or 0.6 m), CCA772 (6.6 ft or 2 m) or CCA774 (13.1 ft or 4 m) cable

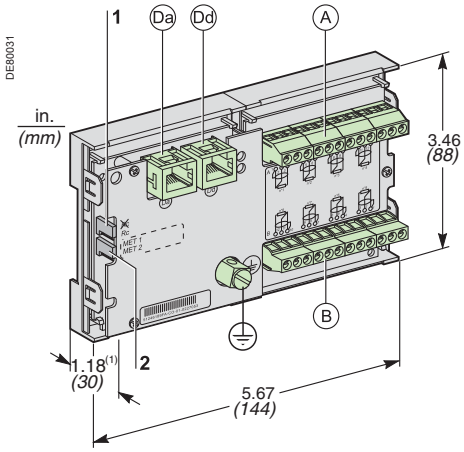
The temperature measurement as in a transformer or motor winding is used by the following protection functions:

- Thermal overload (to account for ambient temperature)
- Temperature monitoring

Characteristics

MET1482 Module		
Weight	0.441 lb (0.2 kg)	
Assembly	On symmetrical DIN rail	
Operating temperature	-13 °F to +158 °F (-25 °C to +70 °C)	
Environmental characteristics	Same characteristics as Sepam base units	
Temperature Sensors	**Pt100**	**Ni100 / Ni120**
Isolation from ground	None	None
Current injected in RTD	4 mA	4 mA

DE80031



(1) *70 mm (2.8 in) with CCA77x cable connected.*

Description and Dimensions

(A) Terminal block for RTDs 1 to 4.

(B) Terminal block for RTDs 5 to 8.

(Da) RJ45 connector to connect the module to the base unit with a CCA77x cable

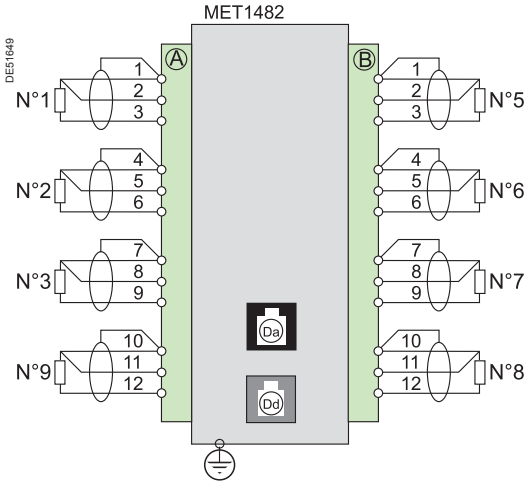
(Dd) RJ45 connector to link up the next remote module with a CCA77x cable (according to application).

⏚ Grounding/grounding terminal.

1 Jumper for impedance matching with load resistor (Rc), to be set to:
- ■ ~~Rc~~, if the module is not the last interlinked module (default position)
- ■ Rc, if the module is the last interlinked module.

2 Jumper used to select module number, to be set to:
- ■ MET1: 1st MET1482 module, to measure temperatures T1 to T8 (default position)
- ■ MET2: 2nd MET1482 module, to measure temperatures T9 to T16 (for Sepam Series 40 and Series 80 only).

MET1482 Temperature Sensor Module



Connection

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device.
- NEVER work alone.
- Check that the temperature sensors are isolated from all voltages.

Failure to follow these instructions will result in death or serious injury.

Connecting the Grounding Terminal

Connecting the grounding terminal is accomplished by using a tinned copper braid with cross-section ≥ AWG 10 (6 mm²) or cable with cross-section ≥ AWG 12 (2.5 mm²) and length ≤ 7.9 in (200 mm), fitted with a 0.16 in (4 mm) ring lug. Check the tightness (maximum tightening torque 19.5 lb-in or 2.2 Nm).

Connecting RTDs to Screw-Type Connectors

- 1 wire with cross-section AWG 24-12 (0.2 to 2.5 mm²)

Recommended cross-sections according to distance:

- Up to 330 ft (100 m) ≥ AWG 18 (1 mm²)
- Up to 990 ft (300 m) ≥ AWG 16 (1.5 mm²)
- Up to 0.62 mi (1 km) ≥ AWG 12 (2.5 mm²)

Maximum distance between sensor and module: 0.62 mi (1 km).

Wiring Precautions

- Shielded cabling is preferred. Using unshielded cables can cause measurement errors which vary according to the level of surrounding electromagnetic disturbance
- Only connect the shielding at the MET1482 end, in the shortest manner possible, to the corresponding terminals of connectors Ⓐ and Ⓑ
- Do not connect the shielding at the RTD end

Accuracy derating according to wiring

The error Dt is proportional to the length of the cable and inversely proportional to the cable cross-section:

$$\Delta t(^{\circ}C) = 2 \times \frac{L(km)}{S(mm^2)}$$

- ±2.1°C/km for 0.93 mm² cross-section (AWG 18)
- ±1°C/km for 1.92 mm² cross-section (AWG 14)

MSA141
Analog Output Module

MSA141 Analog Output Module

Function

The MSA141 module converts one of the Sepam measurements into an analog signal:
- selection of the measurement to be converted by parameter setting
- 0-10 mA, 4-20 mA, or 0-20 mA analog signal according to parameter setting
- scaling the analog signal by setting minimum and maximum values of the converted measurement.

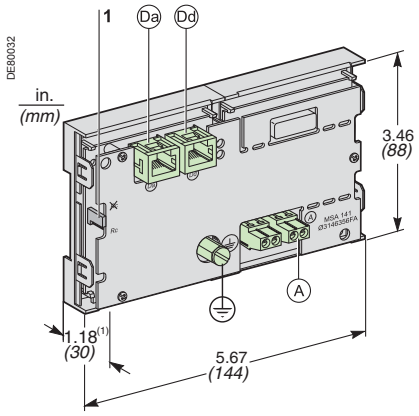
Example: the setting used to have phase current 1 as a 0-10 mA analog output with a dynamic range of 0 to 300 A is:
- minimum value = 0
- maximum value = 3000

- a single module for each Sepam base unit, to be connected by one of the CCA770 (2 ft or 0.6m), CCA772 (6.6 ft or 2m) or CCA774 (13.1 ft or 4m) cables.

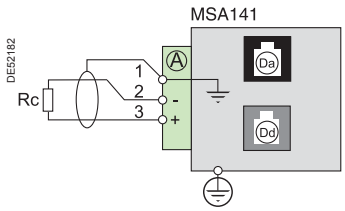
The analog output can also be remotely managed via the communication network.

Characteristics

MSA141 Module				
Weight	0.441 lb (0.2 kg)			
Assembly	On symmetrical DIN rail			
Operating temperature	-13 °F to +158 °F (-25 °C to +70 °C)			
Environmental characteristics	Same characteristics as Sepam base units			
Analog Output				
Current	4-20 mA, 0-20 mA, 0-10 mA			
Scaling (no data input checking)	Minimum value Maximum value			
Load impedance	< 600 W (including wiring)			
Accuracy	0.5 %			
Available Measurements	**Unit**	**Series 20**	**Series 40**	**Series 80**
Phase and residual currents	0.1 A	■	■	■
Line-to-neutral and line-to-line voltages	1 V	■	■	■
Frequency	0.01 Hz	■	■	■
Thermal capacity used	1 %	■	■	■
Temperatures	1 °C	■	■	■
Active power	0.1 kW		■	■
Reactive power	0.1 kvar		■	■
Apparent power	0.1 kVAR		■	■
Power factor	0.01			■
Remote setting via communication link		■	■	■



(1) *70 mm (2.8 in) with CCA77x cable connected*



Description and Dimensions

- (A) Terminal block for analog output.
- (Da) RJ45 socket to connect the module to the base unit with a CCA77x cable.
- (Dd) RJ45 socket to link up the next remote module with a CCA77x cable (according to application).
- ⏚ Grounding terminal.

1 Jumper for impedance matching with load resistor (Rc), to be set to:
- ■ ~~Rc~~, if the module is not the last interlinked module (default position)
- ■ Rc, if the module is the last interlinked module.

Connection

Connecting the Grounding Terminal

Use a tinned copper braid with cross-section ≥ AWG 10 (6 mm²) or cable with cross-section ≥ AWG 12 (2.5 mm²) and length ≤ 7.9 in (200 mm), equipped with a 0.16 in (4 mm) ring lug. Check the tightness (maximum tightening torque 19.5 lb-in or 2.2 Nm).

Connection of Analog Output to Screw-Type Connector
- 1 wire with cross-section AWG 24-12 (0.2 to 2.5 mm²)
- or 2 wires with cross-section AWG 24-18 (0.2 to 1 mm²).

Wiring Precautions
- Shielded cables are preferred
- Use tinned copper braid to connect the shielding at least at the MSA141 end

DSM303
Remote Advanced UMI Module

PE50127

DSM303 remote advanced UMI module.

Function

When associated with a Sepam that does not have its own advanced user-machine interface, the DSM303 offers all the functions available on a Sepam integrated advanced UMI. It can be installed on the front panel of a room in the most suitable operating location:

- reduced depth < 1.2 in (30 mm)
- a single module for each Sepam, to be connected by one of the CCA772 (6.6 ft or 2 m) or CCA774 (13.1 ft or 4 m) cables

The module cannot be connected to Sepam units with integrated advanced UMIs.

Characteristics

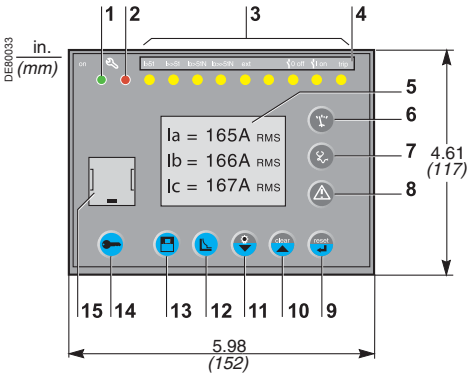
DSM303 Module	
Weight	0.3 kg (0.661 lb)
Assembly	Flush-mounted
Operating temperature	-25 °C to +70 °C (-13 °F to +158 °F)
Environmental characteristics	Same characteristics as for Sepam base units

DSM303
Remote Advanced UMI Module

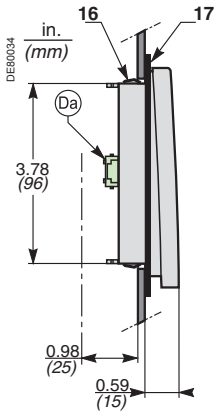
Description and Dimensions

The module is simply flush-mounted and secured by its clips. No additional screw-type fastening is required.

Front view



Side view

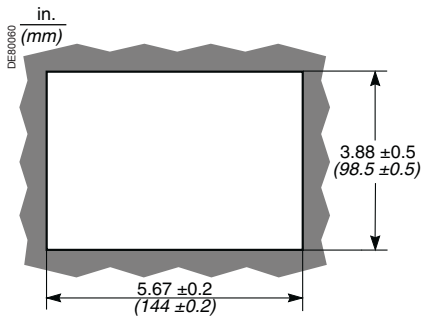


1 Green LED: Sepam on.
2 Red LED:
- steadily on: module unavailable
- flashing: Sepam link unavailable.

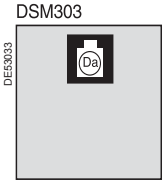
3 9 yellow LEDs.
4 Label identifying the LEDs.
5 Graphic LCD screen.
6 Display of measurements.
7 Display of switchgear, network and machine diagnosis data.
8 Display of alarm messages.
9 Sepam reset (or confirm data entry).
10 Alarm acknowledgment and clearing (or move cursor up).
11 LED test (or move cursor down).
12 Access to protection settings.
13 Access to Sepam parameters.
14 Entry of 2 passwords.
15 PC connection port.
16 Mounting clip.
17 Gasket to ensure NEMA 12 tightness
(gasket supplied with the DSM303 module, to be installed if necessary).

(Da) RJ45 lateral output connector to connect the module to the base unit with a CCA77x cable.

Cut-out for flush-mounting (mounting plate thickness < 3 mm or 0.12 in)



DSM303



Connection

(Da) RJ45 socket to connect the module to the base unit with a CCA77x cable.

The DSM303 module is always the last interlinked remote module and it systematically ensures impedance matching by load resistor (Rc).

MCS025
Synchro-Check Module

PE50285

MCS025 synchro-check module.

Function

The MCS025 module checks the voltages upstream and downstream of a circuit breaker to verify that the two voltages are in sync before the circuit breaker closes (ANSI 25). It checks the differences in amplitude, frequency, and phase between the two measured voltages, taking into account dead line/bus conditions.

Three relay outputs may be used to send the close enable command to several Sepam Series 80 units.

The circuit-breaker control function of each Sepam Series 80 unit will take this close enable into account.

The settings for the synchro-check function and the measurements carried out by the module may be accessed by the SFT2841 setting and operating software, similar to the other settings and measurements for the Sepam Series 80.

The MCS025 module is supplied ready for operation with:
- the CCA620 connector for connection of the relay outputs and the power supply
- the CCT640 connector for voltage connection
- the CCA785 cable for connection between the module and the Sepam Series 80 base unit

Characteristics

MCS025 Module					
Weight		2.98 lb (1.35 kg)			
Assembly		With the AMT840 accessory			
Operating temperature		-13 °F to +158 °F (-25 °C to +70 °C)			
Environmental characteristics		Same characteristics as Sepam base units			
Voltage Inputs					
Input impedance		> 100 kW			
Burden		< 0.015 VA (VT 100 V)			
Continuous thermal withstand		240 V			
1-second overload		480 V			
Relay Outputs					
Relay Outputs O1 and O2					
Voltage	DC	24/48 V DC	127 V DC	220 V DC	
	AC (47.5 to 63 Hz)				100 to 240 V AC
Continuous current		8 A	8 A	8 A	8 A
Breaking capacity	Resistive load	8 A / 4 A	0.7 A	0.3 A	
	Load L/R < 20 ms	6 A / 2 A	0.5 A	0.2 A	
	Load L/R < 40 ms	4 A / 1 A	0.2 A	0.1 A	
	Resistive load				8 A
	Load pf > 0.3				5 A
Making capacity		< 15 ms for 200 ms			
Isolation of outputs from other isolated groups		Enhanced			
Relay Outputs O3 and O4 (O4 not used)					
Voltage	DC	24/48 V DC	127 V DC	220 V DC	
	AC (47.5 to 63 Hz)				100 to 240 V AC
Continuous current		2 A	2 A	2 A	2 A
Breaking capacity	Load L/R < 20 ms	2 A / 1 A	0.5 A	0.15 A	
	Load pf > 0.3				5 A
Isolation of outputs from other isolated groups		Enhanced			

Power Supply		
Voltage	24 to 250 V DC, -20 % / +10 %	110 to 240 V AC, -20 % / + 0 % 47.5 to 63 Hz
Maximum consumption	6 W	9 VA
Inrush current	< 10 A for 10 ms	< 15 A for one half period
Acceptable momentary outages	10 ms	10 ms

MCS025
Synchro-Check Module

1 MCS025 module

(A) CCA620 20-pin connector for:
- auxiliary power supply
- 4 relay outputs:
  - O1, O2, O3: close enable.
  - O4: not used

(B) CCT640 connector (line-to-neutral or phase-to-phase) for the two input voltages to be synchronized

(C) RJ45 connector, not used

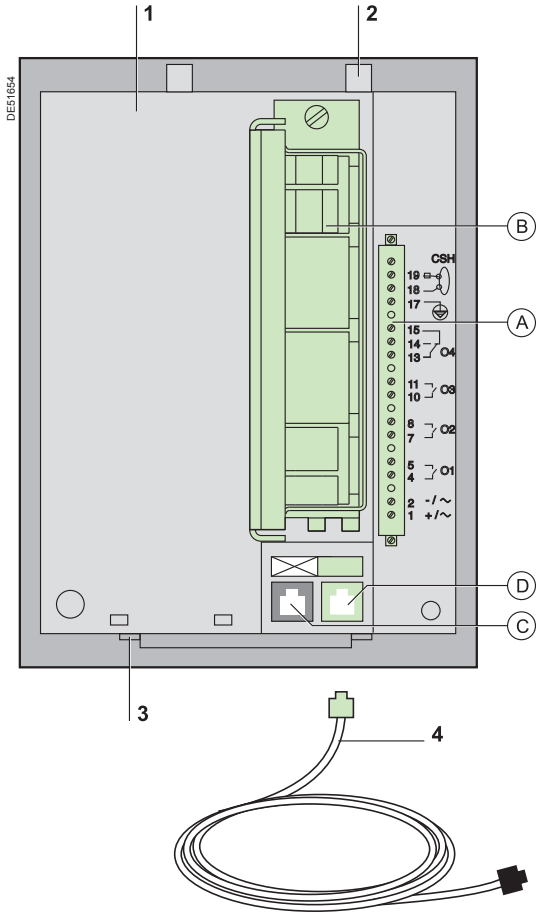
(D) RJ45 connector for module connection to the Sepam Series 80 base unit, either directly or via another remote module.

2 Two mounting clips

3 Two holding pins for the flush-mount position

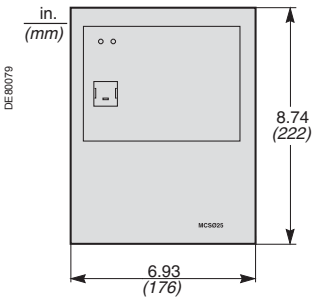
4 CCA785 connection cable

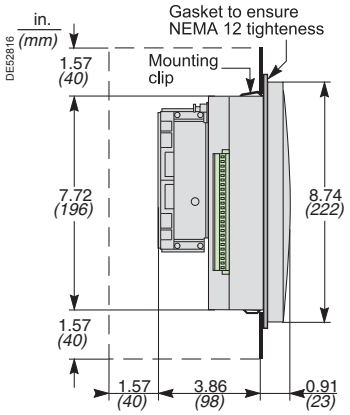
Description



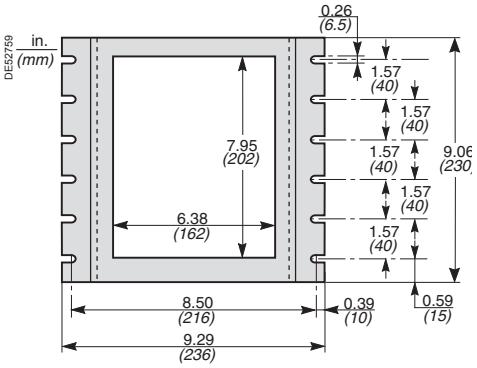
MCS025
Synchro-Check Module

Dimensions





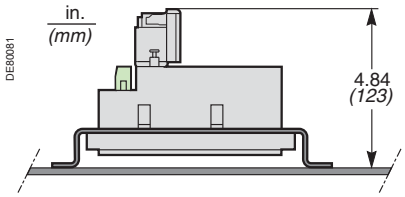
MCS025.



AMT840 mounting plate.

Assembly with AMT840 Mounting Plate

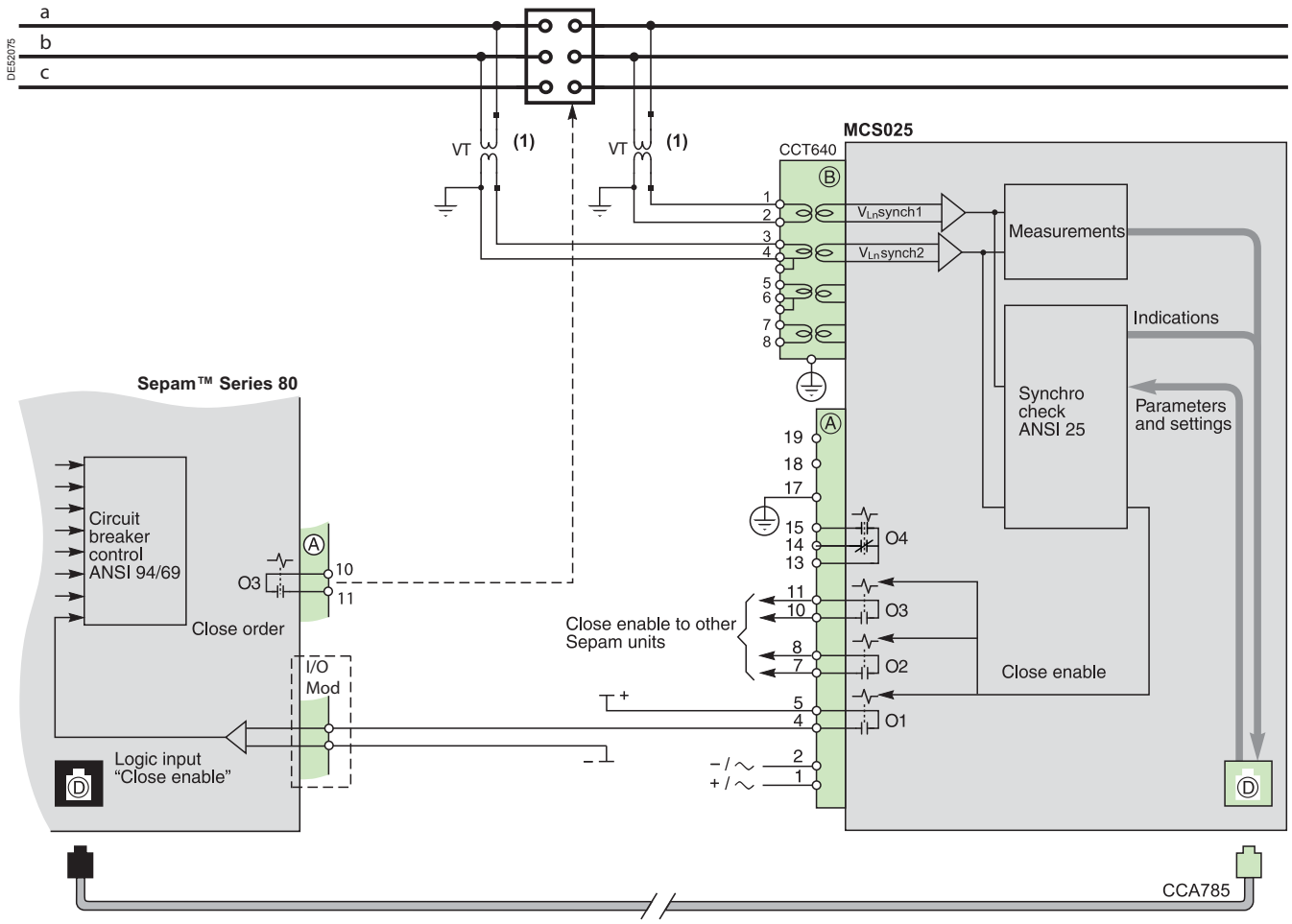
The MCS025 module should be mounted at the back of the compartment using the AMT840 mounting plate.



Connection Characteristics

Connector	Type	Reference	Wiring
(A)	Screw-type	CCA620	■ Wiring with no fittings: □ 1 wire with maximum cross-section 0.2 to 2.5 mm² (> AWG 24-12) or 2 wires with cross-section 0.2 to 1 mm² (>AWG 24-16) □ stripped length: 8 to 10 mm (0.31 à 0.39 in) ■ Wiring with fittings: □ recommended wiring with Telemecanique fittings: - DZ5CE015D for 1 wire 1.5 mm2 (AWG 16) - DZ5CE025D for 1 wire 2.5 mm2 (AWG 12) - AZ5DE010D for 2 x 1 mm² wires (AWG 18) □ wire length: 8.2 mm (0.32 in) □ stripped length: 8 mm (0.31 in)
(B)	Screw-type	CCT640	VT wiring: same as wiring of the CCA620 Grounding connection: by 4 mm (0.15 in) ring lug
(D)	Orange RJ45 connector		CCA785, special prefabricated cable supplied with the MCS025 module: ■ orange RJ45 connector for connection to port (D) on the MCS025 module ■ black RJ45 connector for connection to the Sepam Series 80 base unit, either directly or via another remote module.

MCS025
Synchro-Check Module



(1) Line-to-line or line-to-neutral connection.

CAUTION

HAZARD OF NON-OPERATION

The MCS025 module must ALWAYS be connected with the special CCA785 cable, supplied with the module and equipped with an orange RJ45 plug and a black RJ45 plug.

Failure to follow this instruction can cause equipment damage.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device.
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Screw tight all terminals, even those not in use.

Failure to follow these instructions will result in death or serious injury.

Selection Guide

There are two types of Sepam communication accessories:
- communication interfaces, which are essential for connecting Sepam to the communication network
- converters and other accessories, as options, which are used for complete implementation of the communication network.

Communication-Interface Selection Guide

		ACE9492	ACE959	ACE937	ACE969TP		ACE969FO		ACE850TP (4)	ACE850FO (4)
Type of Network										
		S-LAN or E-LAN (1)	S-LAN or E-LAN (1)	S-LAN or E-LAN (1)	S-LAN	E-LAN	S-LAN	E-LAN	S-LAN and E-LAN	S-LAN and E-LAN
Protocol										
Modbus RTU		■	■	■	■ (3)	■	■ (3)	■	■	■
DNP3					■ (3)		■ (3)			
IEC 60870-5-103					■ (3)		■ (3)			
Modbus TCP/IP									■ (3)	■ (3)
IEC 61850									■ (3)	■ (3)
Physical Interface										
RS485	2-wire	■			■	■		■		
	4-wire		■							
Fiber optic ST	Star			■			■			
	Ring						■ (2)			
10/100 base T	1 port								■	
100 base FX	1 port									■
Power Supply										
CC		Supplied by Sepam	Supplied by Sepam	Supplied by Sepam	24 to 250 V		24 to 250 V		24 to 250 V	24 to 250 V
CA					110 to 240 V		110 to 240 V		110 to 240 V	110 to 240 V
See details on page		**160**	**161**	**162**	**163**		**163**			

(1) *Only one connection possible, S-LAN or E-LAN.*
(2) *Except with the Modbus protocol.*
(3) *Not simultaneously (1 protocol per application).*
(4) *Soon available for Sepam Series 40 and series 80.*

Converter Selection Guide

	ACE9092	ACE919CA	ACE919CC	EGX100	EGX400	ECI850
Converter						
Physical interface	1 port RS232	1 port RS485 port 2-wire	1 port RS485 port 2-wire	1 Ethernet port 10/100 base T	2 Ethernet ports 10/100 base T 100 base F	1 Ethernet port 10/100 base T
Modbus RTU	■ (1)	■ (1)	■ (1)			
IEC 60870-5-103	■ (1)	■ (1)	■ (1)			
DNP3	■ (1)	■ (1)	■ (1)			
Modbus TCP/IP				■	■	
IEC 61850						■
To Sepam						
Physical interface	1 port RS485 2-wire	1 port RS485 2-wire	1 port RS485 2-wire	1 port RS485 2-wire or 4-wire	2 ports RS485 2-wire or 4-wire	1 port RS485 2-wire or 4-wire
Distributed power supply RS485	■	■	■			
Modbus RTU	■ (1)	■ (1)	■ (1)	■	■	■
IEC 60870-5-103	■ (1)	■ (1)	■ (1)			
DNP3	■ (1)	■ (1)	■ (1)			
Power Supply						
DC			24 to 48 V	24 V	24 V	24 V
AC	110 to 220 V AC	11to à 220 V AC			100 to 240 V AC (with adapter)	
See details on page	**168**	**170**	**170**	**176**	**177**	

(1) *The supervisor protocol is the same as the Sepam protocol.*

Note: All** these **interfaces accept the E-LAN protocol.

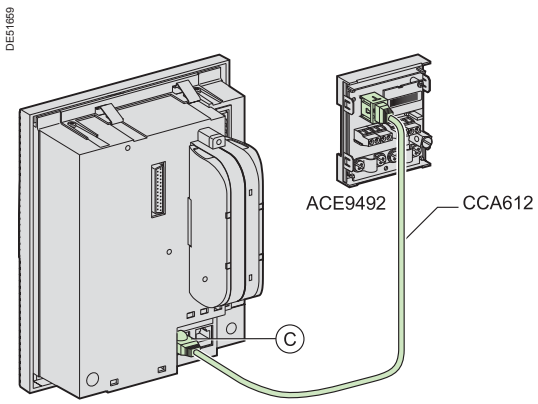
CCA612 Connection Cable

Plugging into Sepam

Cable used to connect a communication interface to a Sepam base unit:

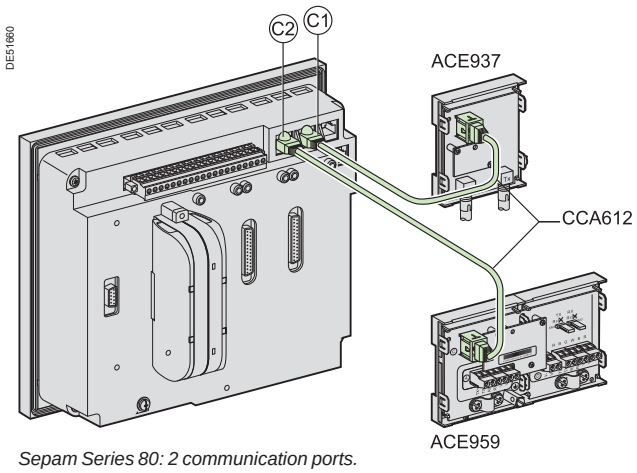
- Length = 9.8 ft (3 m)
- Fitted with two green RJ45 plugs.

Sepam Series 20 and Series 40



Sepam Series 20 and Sepam Series 40: 1 communication port

Sepam Series 80



Sepam Series 80: 2 communication ports.

Connecting to the Communication Network

RS485 Network Cable	2-wire	4-wire
RS485 medium	1 shielded twisted pair	2 shielded twisted pairs
Distributed power supply	1 shielded twisted pair	1 shielded twisted pair
Shielding	Tinned copper braid, coverage > 65%	
Characteristic impedance	120 W	
Gauge	AWG 24	
Resistance per unit length	< 62.1 W/mi (100 W/km)	
Capacitance between conductors	< 18.3 pF/ft (60 pF/m)	
Capacitance between conductor and shielding	< 30.5 pF/ft (100 pF/m)	
Maximum length	4270 ft (1300 m)	

Fiber Optic				
Fiber type	Graded-index multimode silica			
Wavelength	820 nm (invisible infrared)			
Type of connector	ST (BFOC bayonet fiber optic connector)			
Fiber Optic Diameter (µm)	**Numerical Aperture (NA)**	**Maximum Attenuation (dBm/km)**	**Minimum Optical Power Available (dBm)**	**Maximum Fiber Length**
50/125	0.2	2.7	5.6	2300 ft (700 m)
62.5/125	0.275	3.2	9.4	5900 ft (1800 m)
100/140	0.3	4	14.9	9200 ft (2800 m)
200 (HCS)	0.37	6	19.2	8500 ft (2600 m)

ACE9492
2-wire RS485 Network Interface

ACE9492 2-wire RS485 network connection interface

Function

The ACE9492 interface performs two functions:

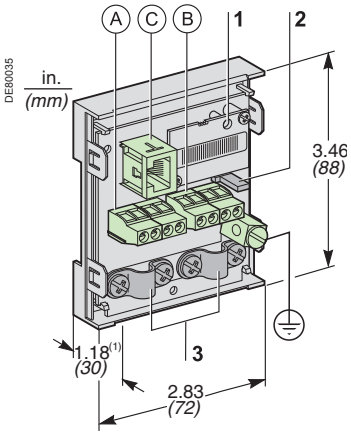
- Electrical interface between Sepam and a 2-wire RS485 communication network
- Main network cable branching box for the connection of a Sepam with a CCA612 cable.

Characteristics

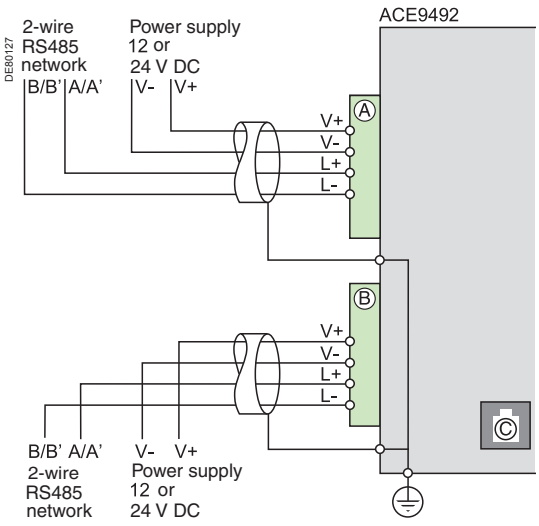
ACE9492 Module	
Weight	0.22 lb (0.1 kg)
Assembly	On symmetrical DIN rail
Operating temperature	-13°F to +158°F (-25°C to +70°C)
Environmental characteristics	Same characteristics as Sepam base units
2-wire RS485 Electrical Interface	
Standard	EIA 2-wire RS485 differential
Distributed power supply	External, 12 V DC or 24 V DC ±10%
Power consumption	16 mA in receiving mode
	40 mA maximum in sending mode

Maximum Length of 2-wire RS485 Network with Standard Cable

Number of Sepam Units	Maximum Length with 12 V DC Power Supply	Maximum Length with 24 V DC Power Supply
5	1000 ft (320 m)	3300 ft (1000 m)
10	590 ft (180 m)	2500 ft (750 m)
20	520 ft (160 m)	1500 ft (450 m)
25	410 ft (125 m)	1200 ft (375 m)



***(1)** 2.8 in (70 mm) with CCA612 cable connected*



***Note: The** shield connection should be grounded at only one end of the serial daisy chain.*

Description and Dimensions

(A) and (B) Terminal blocks for network cable

(C) RJ45 socket to connect the interface to the base unit with a CCA612 cable

(⏚) Grounding terminal

1 Link activity LED, flashes when communication is active (sending or receiving in progress).

2 Jumper for RS485 network line-end impedance matching with load resistor (Rc = 150 Ω), to be set to:

- ~~Rc~~, if the module is not at one end of the network (default position)
- Rc, if the module is at one end of the network.

3 Network cable clamps (inner diameter of clamp = 0.24 in or 6 mm).

Connection

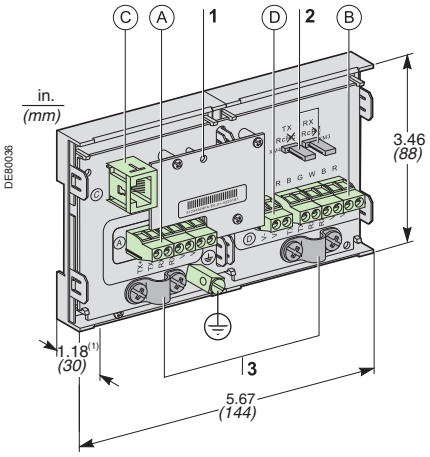
- Connection of network cable to screw-type terminal blocks (A) and (B)
- Connection of the grounding terminal by tinned copper braid with cross-section ≥ AWG 10 (6 mm²) or cable with cross-section ≥ AWG 12 (2.5 mm²) and length ≤ 7.9 in (200 mm), fitted with a 0.16 in (4 mm) ring lug. Check the tightness (maximum tightening torque 19.5 lb-in (2.2 Nm).
- The interfaces are fitted with clamps to hold the network cable and recover shielding at the incoming and outgoing points of the network cable:
  - the network cable must be stripped
  - the cable shielding braid must be around and in contact with the clamp
- The interface is to be connected to connector (C) on the base unit using a CCA612 cable (length = 9.8 ft or 3 m, green fittings)
- The interfaces are to be supplied with 12 V DC or 24 V DC.

ACE959
4-wire RS485 Network Interface

PE80023

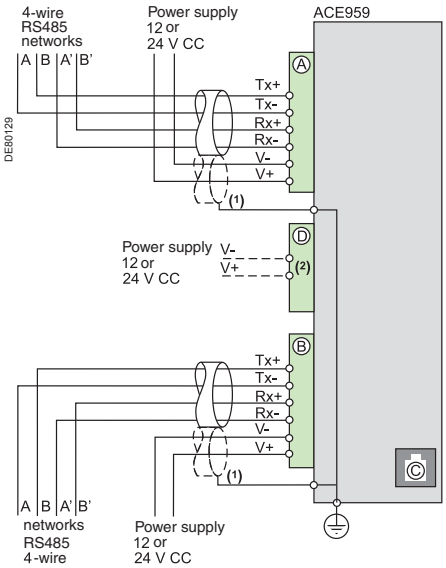
ACE959 4-wire RS485 network connection interface.

DE80036



***(1)** 70 mm (2.8 in) with CCA612 cable connected*

DE80129



***(1)** Distributed power supply with separate wiring or included in the shielded cable (3 pairs).*
***(2)** Terminal block for connection of the distributed power supply module.*

***Note: The** shield connection should be grounded at only one end of the serial daisy chain.*

Function

The ACE959 interface performs two functions:

- Electrical interface between Sepam and a 4-wire RS485 communication network
- Main network cable branching box for the connection of a Sepam with a CCA612 cable.

Characteristics

ACE959 Module	
Weight	0.441 lb (0.2 kg)
Assembly	On symmetrical DIN rail
Operating temperature	-13°F to +158°F (-25°C to +70°C)
Environmental characteristics	Same characteristics as Sepam base units

4-wire RS485 Electrical Interface	
Standard	EIA 4-wire RS485 differential
Distributed power supply	External, 12 V DC or 24 V DC ±10%
Power consumption	16 mA in receiving mode
	40 mA maximum in sending mode

Maximum Length of 4-wire RS485 Network with Standard Cable

Number of Sepam units	Maximum length with 12 V DC power supply	Maximum length with 24 V DC power supply
5	1000 ft (320 m)	3300 ft (1000 m)
10	590 ft (180 m)	2500 ft (750 m)
20	520 ft (160 m)	1500 ft (450 m)
25	410 ft (125 m)	1200 ft (375 m)

Description and Dimensions

Ⓐ and Ⓑ Terminal blocks for network cable
Ⓒ RJ45 socket to connect the interface to the base unit with a CCA612 cable
Ⓓ Terminal block for a separate auxiliary power supply (12 V DC or 24 V DC)
⏚ Grounding terminal

1 Link activity LED, flashes when communication is active (sending or receiving in progress).
2 Jumper for 4-wire RS485 network line-end impedance matching with load resistor (Rc = 150 Ω), to be set to:
- ~~Rc~~, if the module is not at one end of the network (default position)
- Rc, if the module is at one end of the network.

3 Network cable clamps (inner diameter of clamp = 0.24 in or 6 mm).

Connection

- Connection of network cable to screw-type terminal blocks Ⓐ and Ⓑ
- Connection of the grounding terminal by tinned copper braid with cross-section ≥ AWG 10 (6 mm²) or cable with cross-section ≥ AWG 12 (2.5 mm²) and length ≤ 7.9 in (200 mm), fitted with a 0.16 in (4 mm) ring lug. Check the tightness (maximum tightening torque 19.5 lb-in or 2.2 Nm).
- The interfaces are fitted with clamps to hold the network cable and recover shielding at the incoming and outgoing points of the network cable:
  - the network cable must be stripped
  - the cable shielding braid must be around and in contact with the clamp
- The interface is to be connected to connector Ⓒ on the base unit using a CCA612 cable (length = 9.8 ft or 3 m, green fittings)
- The interfaces are to be supplied with 12 V DC or 24 V DC
- The ACE959 can be connected to a separate distributed power supply (not included in shielded cable). Terminal block Ⓓ is used to connect the distributed power supply module.

ACE937
Fiber Optic Interface

PE50024

ACE937 fiber optic connection interface.

Function

The ACE937 interface is used to connect Sepam to a fiber optic communication wye system. This remote module is connected to the Sepam base unit by a CCA612 cable.

Characteristics

ACE937 Module	
Weight	0.22 lb (0.1 kg)
Assembly	On symmetrical DIN rail
Power supply	Supplied by Sepam
Operating temperature	-13°F to +158°F (-25°C to +70°C)
Environmental characteristics	Same characteristics as Sepam base units

Fiber Optic Interface	
Fiber type	Graded-index multimode silica
Wavelength	820 nm (invisible infrared)
Type of connector	ST (BFOC bayonet fiber optic connector)

Fiber Optic Diameter (µm)	Numerical Aperture (NA)	Maximum Attenuation (dBm/km)	Minimum Optical Power Available (dBm)	Maximum Fiber Length
50/125	0.2	2.7	5.6	2300 ft (700 m)
62.5/125	0.275	3.2	9.4	5900 ft (1800 m)
100/140	0.3	4	14.9	9200 ft (2800 m)
200 (HCS)	0.37	6	19.2	8500 ft (2600 m)

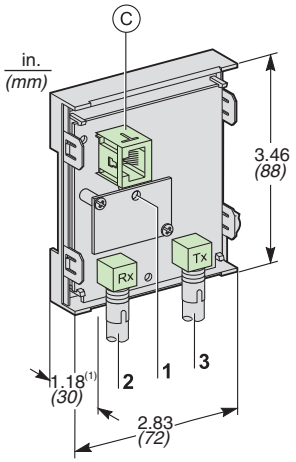
Maximum length calculated with:
- Minimum optical power available
- Maximum fiber attenuation
- Losses in two ST connectors: 0.6 dBm
- Optical power margin: 3 dBm (according to IEC 60870 standard)

Example for a 62.5/125 µm Fiber
Lmax = (9.4 - 3 - 0.6)/3.2 = 1.8 km (1.12 mi)

⚠ CAUTION

HAZARD OF BLINDING
Never look directly into the end of the fiber optic.
Failure to follow this instruction can cause serious injury.

DE80037



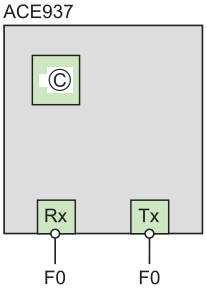
(1) *70 mm (2.8 in) with CCA612 cable connected.*

Description and Dimensions

(C) RJ45 socket to connect the interface to the base unit with a CCA612 cable.

1 Link activity LED, flashes when communication is active (sending or receiving in progress).
2 Rx, female ST type connector (Sepam receiving).
3 Tx, female ST type connector (Sepam sending).

DE51666



Connection

- The sending and receiving fiber optic fibers must be equipped with male ST type connectors
- Fiber optics screw-locked to Rx and Tx connectors

The interface is to be connected to connector (C) on the base unit using a CCA612 cable (length = 3 m or 9.8 ft, green fittings).

ACE969TP and ACE969FO Interfaces Network

PE50470

ACE969TP communication interface

PE50471

ACE969FO communication interface

Function

The ACE969 multi-protocol communication interfaces are for Sepam Series 20, Series 40, and Series 80. They have two communication ports to connect a Sepam to two independent communication networks:

- The S-LAN (Supervisory Local Area Network) port is used to connect Sepam to a communication network dedicated to supervision, using one of the three following protocols:
  - IEC 60870-5-103
  - DNP3
  - Modbus RTU

The communication protocol is selected at the time of Sepam parameter setting.

- The E-LAN (Engineering Local Area Network) port, reserved for Sepam remote parameter setting and operation using the SFT2841 software

There are two versions of the ACE969 interfaces that are identical except for the S-LAN port:

- ACE969TP (Twisted Pair), for connection to an S-LAN network using a 2-wire RS485 serial link
- ACE969FO (Fiber Optic), for connection to an S-LAN network using a fiber-optic connection (wye or ring)

The E-LAN port is always a 2-wire RS485 type port.

ACE969TP and ACE969FO Interfaces Network

Characteristics

ACE969 Module		
Technical Characteristics		
Weight	0.628 lb (0.285 kg)	
Assembly	On symmetrical DIN rail	
Operating temperature	-13°F to +158°F (-25°C to +70°C)	
Environmental characteristics	Same characteristics as Sepam base units	
Power Supply		
Voltage	24 to 250 V DC	110 to 240 V AC
Range	-20%/+10%	-20%/+10%
Maximum consumption	2 W	3 VA
Inrush current	< 10 A 100 ms	
Acceptable ripple content	12%	
Acceptable momentary outages	20 ms	

2-wire RS485 Communication Ports		
Electrical Interface		
Standard	EIA 2-wire RS485 differential	
Distributed power supply	External, 12 V DC or 24 V DC ±10%	
Power consumption	16 mA in receiving mode	
	40 mA in sending mode	
Max. number of Sepam units	25	
Maximum Length of 2-wire RS485 Network		
Number of Sepam Units	**With Distributed Power Supply 12 V DC**	**24 V DC**
5	1000 ft (320 m)	3300 ft (1000 m)
10	590 ft (180 m)	2500 ft (750 m)
20	430 ft (130 m)	1500 ft (450 m)
25	410 ft (125 m)	1200 ft (375 m)

Fiber Optic Communication Port				
Fiber Optic Interface				
Fiber type	Graded-index multimode silica			
Wavelength	820 nm (invisible infrared)			
Type of connector	ST (BFOC bayonet fiber optic connector)			
Maximum Length of Fiber Optic Network				
Fiber Diameter (µm)	**Numerical Aperture (NA)**	**Attenuation (dBm/km)**	**Minimum Optical Power Available (dBm)**	**Maximum Fiber Length**
50/125	0.2	2.7	5.6	2300 ft (700 m)
62.5/125	0.275	3.2	9.4	5900 ft (1800 m)
100/140	0.3	4	14.9	9200 ft (2800 m)
200 (HCS)	0.37	6	19.2	8500 ft (2600 m)

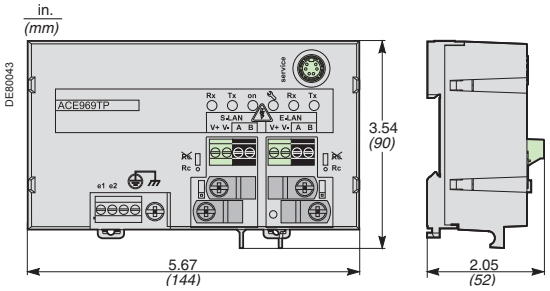
Maximum length calculated with:

- Minimum optical power available
- Maximum fiber attenuation
- Losses in two ST connectors: 0.6 dBm
- Optical power margin: 3 dBm (according to IEC 60870 standard).

Example for a 62.5/125 µm Fiber

Lmax = (9.4 - 3 - 0.6)/3.2 = 1.8 km (1.12 mi).

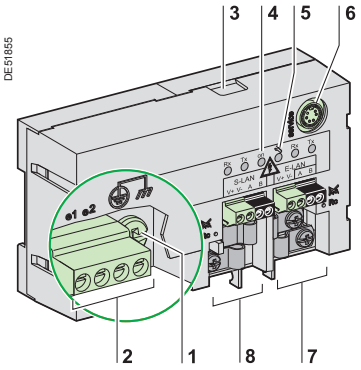
Dimensions



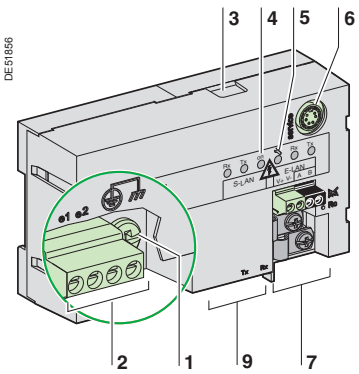
ACE969TP and ACE969FO Interfaces Network
Description

ACE969 Communication Interfaces

ACE969TP



ACE969FO

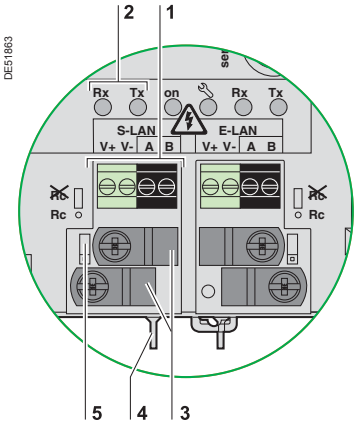


1 Grounding/grounding terminal using supplied braid
2 Power-supply terminal block
3 RJ45 connector to connect the interface to the base unit with a CCA612 cable
4 Green LED: ACE969 energized
5 Red LED: ACE969 interface status
- LED off = ACE969 set up and communication operational
- LED flashing = ACE969 not set up or setup incorrect
- LED remains on = ACE969 has faulted

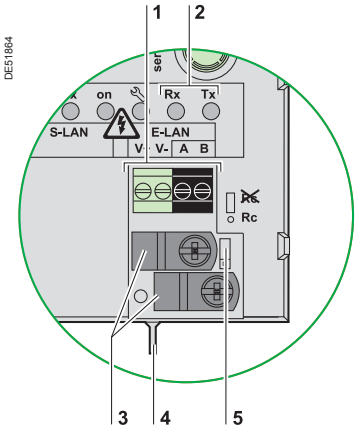
6 Service connector: reserved for software upgrades
7 E-LAN 2-wire RS485 communication port (ACE969TP and ACE969FO)
8 S-LAN 2-wire RS485 communication port (ACE969TP)
9 S-LAN fiber-optic communication port (ACE969FO).

2-wire RS485 Communication Ports

Port S-LAN (ACE969TP)



Port E-LAN (ACE969TP or ACE969FO)



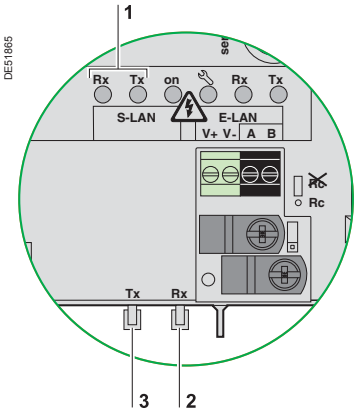
1 2-wire RS485 network terminal block:
- 2 black terminals: connection of RS485 twisted-pair (2 wires)
- 2 green terminals: connection of twisted-pair for distributed power supply

2 Indication LEDs:
- flashing Tx LED: Sepam sending
- flashing Rx LED: Sepam receiving.

3 Clamps and recovery of shielding for two network cables, incoming and outgoing (inner diameter of clamp = 0.236 in or 6 mm)
4 Fixing stud for network cable ties
5 Jumper for RS485 network line-end impedance matching with load resistor (Rc = 150 Ω), to be set to:
- Rc, if the interface is not at the line end (default position)
- Rc, if the interface is at the line end.

Fiber-Optic Communication Port

Port S-LAN (ACE969FO)



1 Indication LEDs:
- flashing Tx LED: Sepam sending
- flashing Rx LED: Sepam receiving.

2 Rx, female ST-type connector (Sepam receiving)
3 Tx, female ST-type connector (Sepam sending).

ACE969TP and ACE969FO Interfaces Network Connection

Power Supply and Sepam

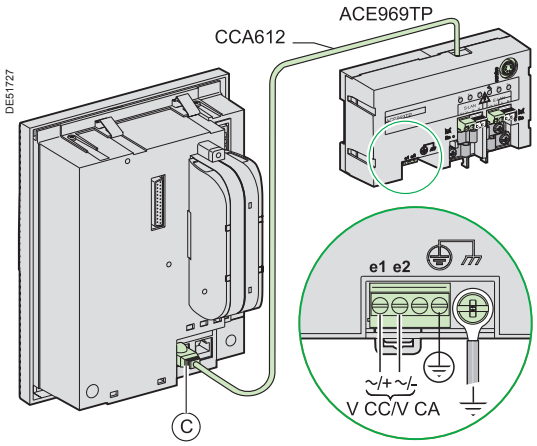
- The ACE969 interface connects to connector C on the Sepam base unit using a CCA612 cable (length = 9.84 ft or 3 m, green RJ45 fittings)
- The ACE969 interface must be supplied with 24 to 250 V DC or 110 to 230 V AC.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

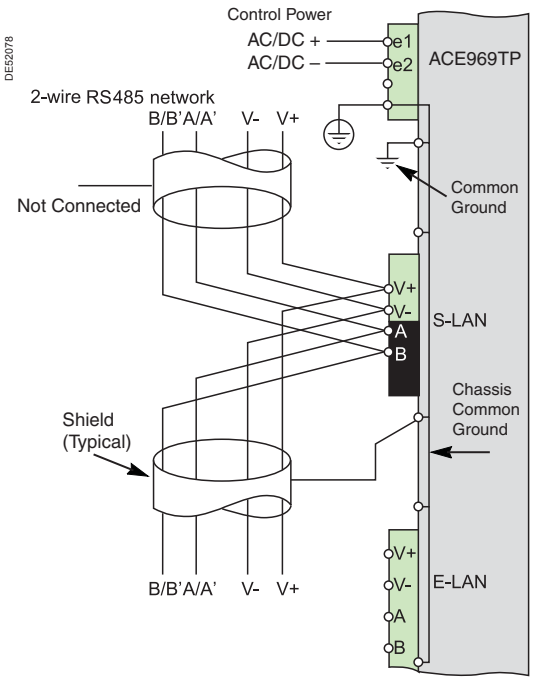
- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device.
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Start by connecting the device to the protective ground and to the functional ground.
- Screw tight all terminals, even those not in use.

Failure to follow these instructions will result in death or serious injury.



Terminals	Type	Wiring
e1-e2 - supply	Screw terminals	■ Wiring with no fittings: □ 1 wire with maximum cross-section 0.2 to 2.5mm² (≥ AWG 24-12) □ or 2 wires with maximum cross-section 0.2 to 1 mm² (≥ AWG 24-18) □ stripped length: 8 to 10 mm (0.31 to 0.39 in) ■ Wiring with fittings: □ recommended wiring with Telemecanique fitting: - DZ5CE015D for 1 wire 1.5 mm² (AWG 16) - DZ5CE025D for 1 wire 2.5 mm² (AWG 12) - AZ5DE010D for 2 wires 1 mm² (AWG 18) □ wire length: 8.2 mm (0.32 in) □ stripped length: 8 mm (0.31 in).
DE51962 ⏚ Protective ground	Screw terminal	1 green/yellow wire, max. length 9.8 ft (3 m) and max. cross-section AWG 12 (2.5 mm²)
DE51945 Functional ground	0.16 in (4 mm) ring lug	Grounding braid, supplied for connection to cubicle grounding

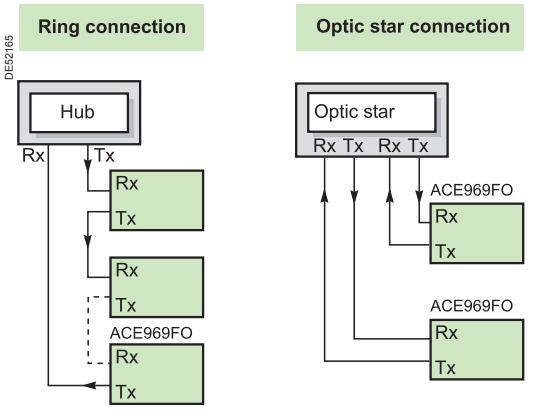
ACE969TP and ACE969FO Interfaces Network Connection



2-wire RS485 Communication Ports (S-LAN or E-LAN)

- Connection of RS485 twisted pair (S-LAN or E-LAN) to black terminals A and B
- Connection of twisted pair for distributed power supply to green terminals V+ and V-
- The interfaces are fitted with clamps to hold the network cable and recover shielding at the incoming and outgoing points of the network cable:
  - the network cable must be stripped
  - the cable shielding must be around and in contact with the clamp
  - shielding continuity of incoming and outgoing cables is ensured by the electrical continuity of the clamps
- All cable clamps are linked by an internal connection to the grounding terminals of the ACE969 interface (protective and functional grounding), that is, the shielding of the RS485 cables is grounded as well
- On the ACE969TP interface, the cable clamps for the S-LAN and E-LAN RS485 networks are grounded

***Note: The** shield connection should be grounded at only one end of the serial daisy chain.*



Fiber Optic Communication Port (S-LAN)

⚠CAUTION

HAZARD OF BLINDING

Never look directly into the fiber optic.

Failure to follow this instruction can cause serious injury.

The fiber optic connection can be made:
- point-to-point to an optic wye system
- in a ring system (active echo)

The sending and receiving fiber optic fibers must be equipped with male ST type connectors.

The fiber optics are screw-locked to Rx and Tx connectors.

ACE9092
RS232/RS485 Converter

PE50035

ACE9092 RS232/RS485 converter.

Function

The ACE9092 converter is used to connect a master/central computer equipped with a V24/RS232 type serial port as a standard feature to stations connected to a 2-wire RS485 network.

After the parameters are set, the ACE9092 converter performs conversion and network polarization. It also automatically dispatches frames between the master and the stations by two-way simplex (half-duplex, single-pair) transmission. This is all done without requiring any flow control signals.

The ACE9092 converter also provides a 12 V DC or 24 V DC supply for the distributed power supply of the Sepam ACE9492, ACE959 or ACE969 interfaces. The communication settings should be the same as the Sepam and supervisor communication settings.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device.
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Start by connecting the device to the protective ground and to the functional ground.
- Screw tight all terminals, even those not in use.

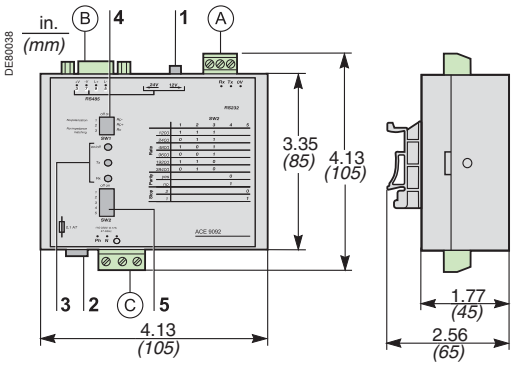
Failure to follow these instructions will result in death or serious injury.

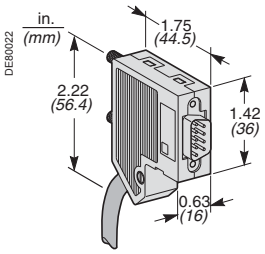
Characteristics

Mechanical Characteristics	
Weight	0.617 lb (0.280 kg)
Assembly	On symmetrical or asymmetrical DIN rail
Electrical Characteristics	
Power supply	110 to 220 V AC ± 10%, 47 to 63 Hz
Galvanic isolation between ACE power supply and frame, and between ACE power supply and interface supply	2000 Vrms, 50 Hz, 1 min
Galvanic isolation between RS232 and RS485 interfaces	1000 Vrms, 50 Hz, 1 min
Protection by time-delayed fuse 5 mm x 20 mm (0.2 in x 0.79 in)	1 A rating
Communication and Sepam Interface Distributed Supply	
Data format	11 bits: 1 start, 8 data, 1 parity, 1 stop
Transmission delay	< 100 ns
Distributed power supply for Sepam interfaces	12 V DC or 24 V DC
Maximum number of Sepam interfaces with distributed supply	12
Environmental Characteristics	
Operating temperature	+23°F to +131°F (-5°C to +55°C)

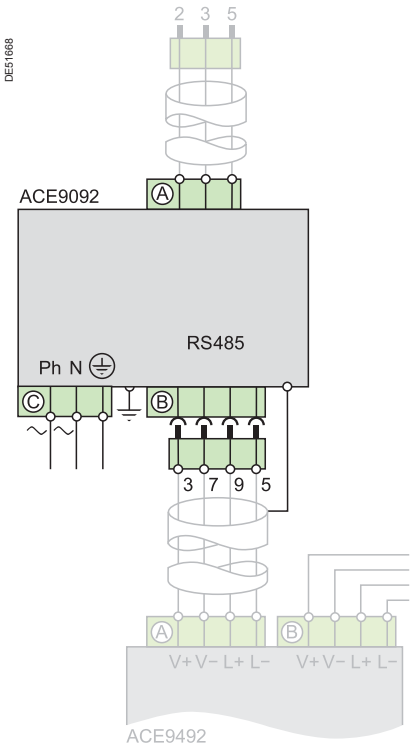
Electromagnetic Compatibility	IEC standard	Value
Fast transient bursts, 5 ns	60255-22-4	4 kV with capacitive tie breaker in common mode 2 kV with direct tie breaker in common mode 1 kV with direct tie breaker in differential mode
1 MHz damped oscillating wave	60255-22-1	1 kV common mode 0.5 kV differential mode
1.2/50 µs pulse waves	60255-5	3 kV common mode 1 kV differential mode

ACE9092
RS232/RS485 Converter





Male 9-pin sub-D connector supplied with the ACE9092.



Description and Dimensions

(A) Terminal block for RS232 link limited to 33 ft (10 m).

(B) Female 9-pin sub-D connector to connect to the 2-wire RS485 network, with distributed power supply.
1 screw-type male 9-pin sub-D connector is supplied with the converter.

(C) Power-supply terminal block

1 Distributed power supply voltage selector switch, 12 V DC or 24 V DC.
2 Protection fuse, unlocked by a 1/4 turn.
3 LEDs:
- ON/OFF: on if ACE9092 is energized
- Tx: on if RS232 sending by ACE9092 is active
- Rx: on if RS232 receiving by ACE9092 is active.

4 SW1, parameter setting of 2-wire RS485 network polarization and line impedance matching resistors.

Function	SW1/1	SW1/2	SW1/3
Polarization at 0 V via Rp -470 W	ON		
Polarization at 5 V via Rp +470 W		ON	
2-wire RS485 network impedance matching by 150 W resistor			ON

5 SW2, parameter setting of asynchronous data transmission rate and format (same parameters as for RS232 link and 2-wire RS485 network).

Rate (baud)	SW2/1	SW2/2	SW2/3		
1200	1	1	1		
2400	0	1	1		
4800	1	0	1		
9600	0	0	1		
19200	1	1	0		
38400	0	1	0		
Format				**SW2/4**	**SW2/5**
With parity check				0	
Without parity check				1	
1 stop bit (compulsory for Sepam)					0
2 stop bits					1

Converter Configuration when Delivered
- 12 V DC distributed power supply
- 11-bit format, with parity check
- 2-wire RS485 network polarization and impedance matching resistors activated.

Connection

RS232 Link
- To AWG 12 (2.5 mm²) screw-type terminal block (A)
- Maximum length 33 ft (10 m)
- Rx/Tx: RS232 receiving/sending by ACE9092
- 0V: Rx/Tx common, do not ground.

2-wire RS485 Link with Distributed Power Supply
- To connector (B) female 9-pin sub-D
- 2-wire RS485 signals: L+, L-
- Distributed power supply: V+ = 12 V DC or 24 V DC, V- = 0 V.

Power Supply
- To AWG 12 (2.5 mm²) screw-type terminal block (C)
- Reversible phase and neutral
- Grounded via terminal block and metal case (ring lug on back of case).

ACE919CA and ACE919CC RS485/RS485 Converters

PE50036

ACE919CC RS485/RS485 converter.

Function

The ACE919 converters are used to connect a master/central computer equipped with an RS485 type serial port as a standard feature to stations connected to a 2-wire RS485 network.

The ACE919 converters perform network polarization and impedance matching without requiring any flow control signals.

The ACE919 converters also provide a 12 V DC or 24 V DC supply for the distributed power supply of the Sepam ACE9492, ACE959 or ACE969 interfaces.

There are two types of ACE919 converter:
- ACE919CC, DC-powered
- ACE919CA, AC-powered.

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

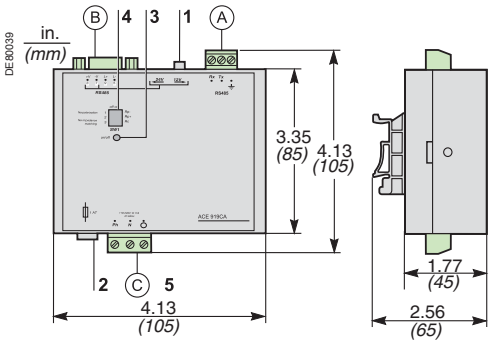
- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device.
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Start by connecting the device to the protective ground and to the functional ground.
- Screw tight all terminals, even those not in use.

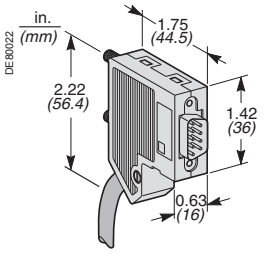
Failure to follow these instructions will result in death or serious injury.

Characteristics

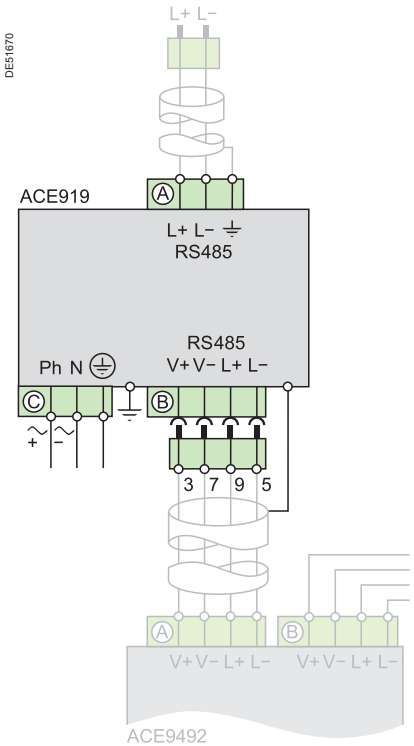
Mechanical Characteristics		
Weight	0.617 lb (0.280 kg)	
Assembly	On symmetrical or asymmetrical DIN rail	
Electrical Characteristics	**ACE919CA**	**ACE919CC**
Power supply	110 to 220 V AC ±10%, 47 to 63 Hz	24 to 48 V DC ±20%
Protection by time-delayed fuse 0.2 in x 0.79 in (5 mm x 20 mm)	1 A rating	1 A rating
Galvanic isolation between ACE power supply and frame, and between ACE power supply and interface supply		2000 Vrms, 50 Hz, 1 min
Communication and Sepam Interface Distributed Supply		
Data format	11 bits: 1 start, 8 data, 1 parity, 1 stop	
Transmission delay	< 100 ns	
Distributed power supply for Sepam interfaces	12 V DC or 24 V DC	
Maximum number of Sepam interfaces with distributed supply	12	
Environmental Characteristics		
Operating temperature	+23°F to +131°F (-5°C to +55°C)	
Electromagnetic Compatibility	**IEC standard**	**Value**
Fast transient bursts, 5 ns	60255-22-4	4 kV with capacitive tie breaker in common mode 2 kV with direct tie breaker in common mode 1 kV with direct tie breaker in differential mode
1 MHz damped oscillating wave	60255-22-1	1 kV common mode 0.5 kV differential mode
1.2/50 µs pulse waves	60255-5	3 kV common mode 1 kV differential mode

ACE919CA and ACE919CC RS485/RS485 Converters





Male 9-pin sub-D connector supplied with the ACE919



Description and Dimensions

(A) Terminal block for 2-wire RS485 link without distributed power supply.

(B) Female 9-pin sub-D connector to connect to the 2-wire RS485 network, with distributed power supply.
1 screw-type male 9-pin sub-D connector is supplied with the converter.

(C) Power supply terminal block.

1 Distributed power supply voltage selector switch, 12 V DC or 24 V DC.
2 Protection fuse, unlocked by a 1/4 turn.
3 ON/OFF LED: ON if ACE919 is energized.
4 SW1, parameter setting of 2-wire RS485 network polarization and line impedance matching resistors.

Function	SW1/1	SW1/2	SW1/3
Polarization at 0 V via Rp -470 W	ON		
Polarization at 5 V via Rp +470 W		ON	
2-wire RS485 network impedance matching by 150 W resistor			ON

Converter Configuration when Delivered
- 12 V DC distributed power supply
- 2-wire RS485 network polarization and impedance matching resistors activated.

Connection

2-wire RS485 Link without Distributed Power Supply
- To 2.5 mm² (AWG 12) screw-type terminal block (A)
- L+, L-: 2-wire RS485 signals
- ⏚ Shielding.

2-wire RS485 Link with Distributed Power Supply
- To connector (B) female 9-pin sub-D
- 2-wire RS485 signals: L+, L-
- Distributed power supply: V+ = 12 V DC or 24 V DC, V- = 0 V.

Power supply
- To AWG 12 (2.5 mm²) screw-type terminal block (C)
- Reversible phase and neutral (ACE919CA)
- Grounded via terminal block and metal case (ring lug on back of case).

Sepam ECI850 Server for IEC 61850

PE80033-36

Sepam ECI850 server for IEC 61850.

Function

The ECI850 connects Sepam Series 20, Series 40, and Series 80 units to an Ethernet network using the IEC 61850 protocol. It acts as the interface between the Ethernet/ IEC 61850 network and a Sepam RS485/Modbus network.

Two PRI surge arresters (catalog number 16595) are supplied with the ECI850 to protect its power supply.

Characteristics

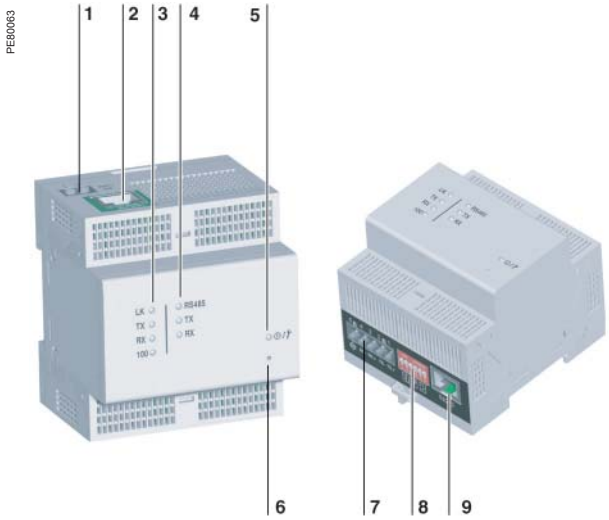
ECI850 Module	
Technical Characteristics	
Weight	0,37 lb (0.17 kg)
Assembly	On symmetrical DIN rail
Power Supply	
Voltage	24 V DC (±10 %) supplied by a class 2 supply
Maximum consumption	4 W
Dielectric strength	1.5 kV
Environmental Characteristics	
Operating temperature	-13 °F to +158 °F (-25 °C to +70 °C)
Storage temperature	-40 °F to +185 °F (-40 °C to +85 °C)
Relative humidity	5 to 95 % (without condensation) at 131 °F (+55 °C)
Pollution degree	Class 2
Degree of protection	IP30
Electromagnetic Compatibility	
Emission Tests	
Emission (radiated and conducted)	EN 55022/EN 55011/FCC Class A
Immunity Tests – Radiated Disturbances	
Electrostatic discharge	EN 61000-4-2
Radiated radio-frequency fields	EN 61000-4-3
Magnetic fields at power frequency	EN 61000-4-8
Immunity Tests – Conducted Disturbances	
Fast transient bursts	EN 61000-4-4
Surges	EN 61000-4-5
Conducted disturbances, induced by radio-frequency fields	EN 61000-4-6
Standards	
International	IEC 60950
United States	UL 508/UL 60950
Canada	cUL (in compliance with CSA C22.2, no. 60950)
Australia / New Zealand	AS/NZS 60950
Certification	
Europe	CE
2-wire/4-wire RS485 Communication Ports	
Electrical interface	
Standard	EIA 2-wire/4-wire RS485 differential
Max. number of Sepam units	8
Maximum Length of 2-wire/4-wire RS485 Network	
Number of Sepam Units	**Maximum Length**
5	3300 ft (1000 m)
8	2500 ft (750 m)
Ethernet Communication Port	
Number of ports	1
Type of port	10/100 Base Tx
Protocols	HTTP, FTP, SNMP, SNTP, ARP, SFT, IEC 61850 TCP/IP
Transmission rate	10/100 Mbits/s

Sepam ECI850 Server for IEC 61850

Characteristics

PRI Surge Arrester	
Electrical Characteristics	
Utilisation voltage	12 to 48 V
Full discharge current	10 kA (8/20 µs wave)
Rated discharge current	5 kA (8/20 µs wave)
Level of protection	70 V
Response time	< 25 ms
Mechanical Operation Indicator	
White	Normal operation
Red	Arrester must be replaced
Connection	
Tunnel terminals	Wires with maximum cross-section of AWG 24-12 (0.5 to 2.5 mm²)

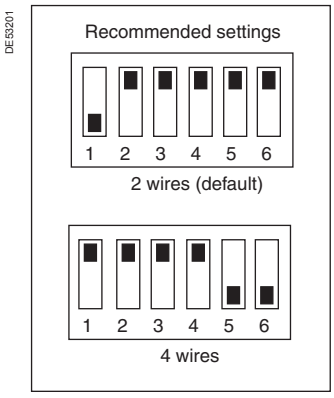
Description



1 ⏻ / 🔧 LED: Power on and maintenance
2 Serial-link LEDs:
- ■ RS485 LED: link to network activated
  - □ On: RS485 mode
  - □ Off: RS232 mode
  - □ flashing TX LED: ECI850 sending
  - □ flashing RX LED: ECI850 receiving

3 Ethernet LEDs:
- ■ green LK LED on: link to network activated
- ■ flashing green Tx LED: ECI850 sending
- ■ flashing green Rx LED: ECI850 receiving
- ■ green 100 LED:
- ■ On: transmission rate = 100 Mbit/s
- ■ Off: transmission rate = 10 Mbit/s

4 10/100 Base Tx port for Ethernet connection via RJ45 connector
5 24 V DC connection
6 Reset button
7 RS485 connector
8 RS485 setup switches
9 RS232 connector



RS485 network setup

RS485 Network Setup

The RS485 setup switches are used to select the network-polarization (bias) and line-impedance matching resistors and the type of RS485 network (2-wire/4-wire). The default settings are for a 2-wire RS485 with network-polarization and line-impedance matching resistors.

Line-Impedance Matching using Resistors	SW1	SW2	SW3	SW4	SW5	SW6
2-wire RS485	OFF	ON				
4-wire RS485	ON	ON				

Polarization (bias)	SW1	SW2	SW3	SW4	SW5	SW6
at 0 V			ON			
at 5 V				ON		

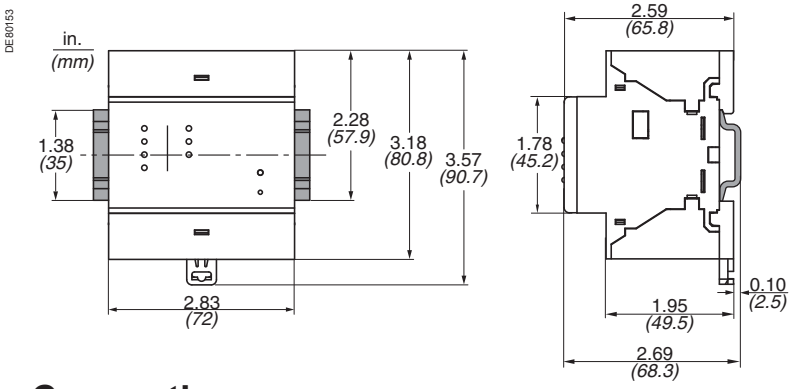
RS485 Network Type	SW1	SW2	SW3	SW4	SW5	SW6
2-wire					ON	ON
4-wire					OFF	OFF

Ethernet Link Set-up

The TCSEAK0100 configuration kit can be used to connect a PC to the ECI850 to set up the Ethernet link.

Sepam ECI850 Server for IEC 61850

Dimensions



⚠ CAUTION

HAZARD OF HIGH VOLTAGE SURGE DAMAGE

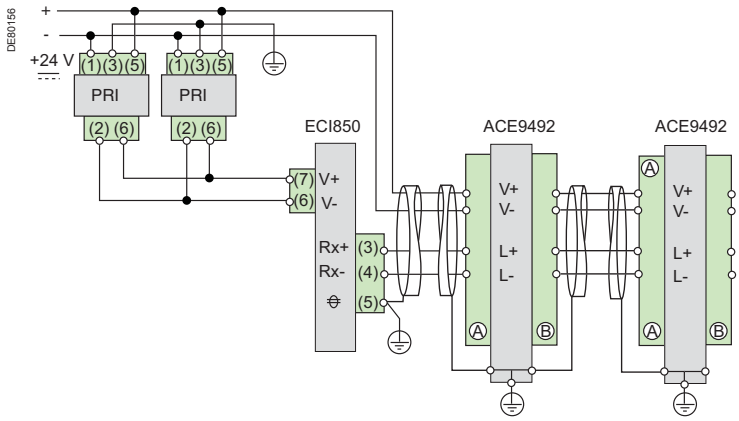
- Connect the two PRI surge arresters as indicated in the diagrams below.
- Check the quality of the grounding conductors connected to the surge arresters.

The equipment may be damaged if these instructions are not followed.

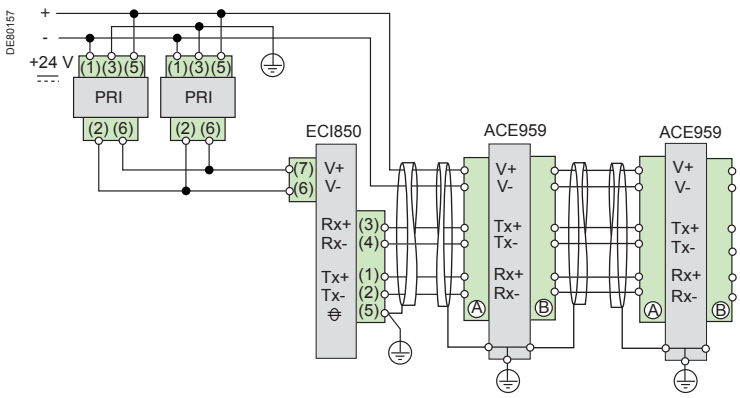
Connection

- Connect the supply and the RS485 twisted pair using the ≤ 2.5 mm² cable (≥ AWG 12).
- Connect the 24 V DC supply and ground to inputs 1, 5 and 3 on the PRI surge arresters supplied with the ECI850.
- Connect outputs 2 and 6 of PRI surge arresters (catalog number 16595) to the - and + terminals on the terminal block with black screws.
- Connect the RS485 twisted pair (2 or 4 wires) to the terminals (RX+ RX- or RX+ RX- TX+ TX-) on the terminal block with black screws.
- Connect the shielding of the RS485 twisted pair to the ⏀ terminal on the terminal block with black screws.
- Connect the Ethernet cable to the green RJ45 connector.

2-Wire RS485 Network



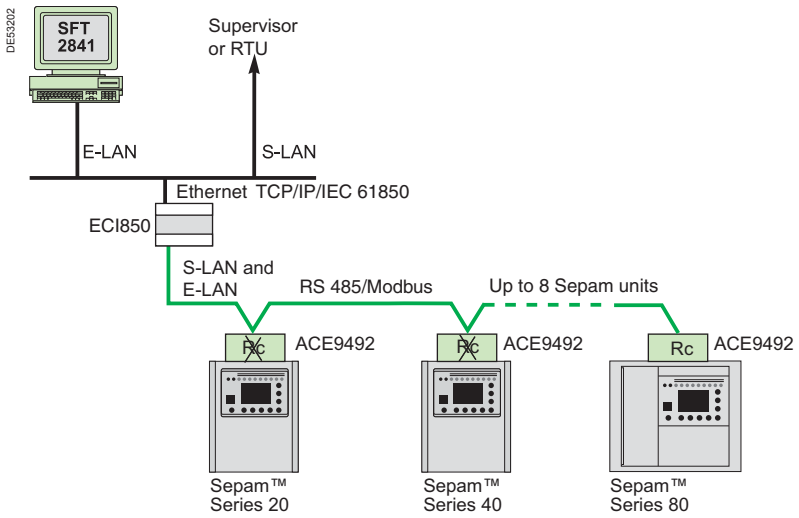
4-Wire RS485 Network



Sepam ECI850 Server for IEC 61850

Architecture Example

The diagram below shows an example of a communication architecture using the ECI850.



***Note: Rc** = line-impedance matching resistor.*

Ethernet EGX100 Gateway

E90463

Transparent Ready

PB101556

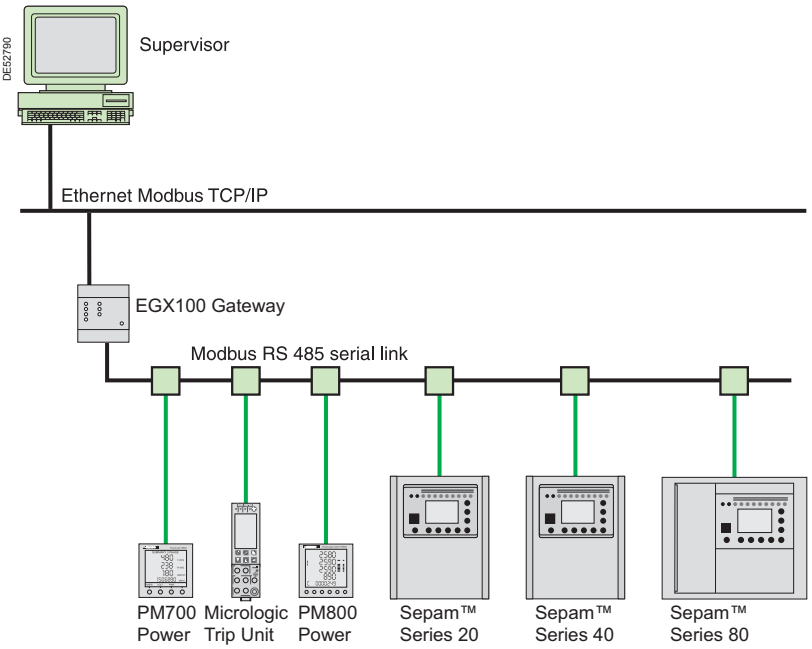
Function

The EGX100 serves as an Ethernet gateway for PowerLogic® System devices and for any other communicating devices utilizing the Modbus protocol.

The EGX100 gateway offers complete access to status and measurement information provided by the connected devices, for example, via the System Manager™ Software (SMS) installed on a PC.

Architecture

DE52790



Setup

Setup via an Ethernet Network

Once connected to an Ethernet network, the EGX100 gateway can be accessed by a standard internet browser via its IP address to:

- specify the IP address, subnet mask, and gateway address of the EGX gateway
- configure the serial port parameters (baud rate, parity, protocol, mode, physical interface, and timeout value)
- create user accounts
- create or update the list of the connected products with their Modbus communication parameters
- configure IP filtering to control access to serial devices
- access Ethernet and serial port diagnostic data
- update the firmware

Setup via a Serial Connection

Serial setup is carried out using a PC connected to the EGX100 via an RS232 link. This setup:

- specifies the IP address, subnet mask, and gateway address of the EGX gateway
- specifies the language used for the setup session

Ethernet EGX400 Server

PE50538

Web-enabled Power & Control

Transparent Ready

PE50270

Ethernet EGX400 gateway

Function

The EGX400 server is used as an Ethernet coupler for Sepam relays, PowerLogic® devices, and any other communicating devices operating under the Modbus RS485 protocol. The EGX400 contains HTML pages (set up using the WPG software tool) that can be accessed using a standard internet browser. The HTML pages are used to display the information provided by the devices connected to the server.

Supervisor and Internet Browser

The EGX400 server makes it possible to implement two types of user interface:

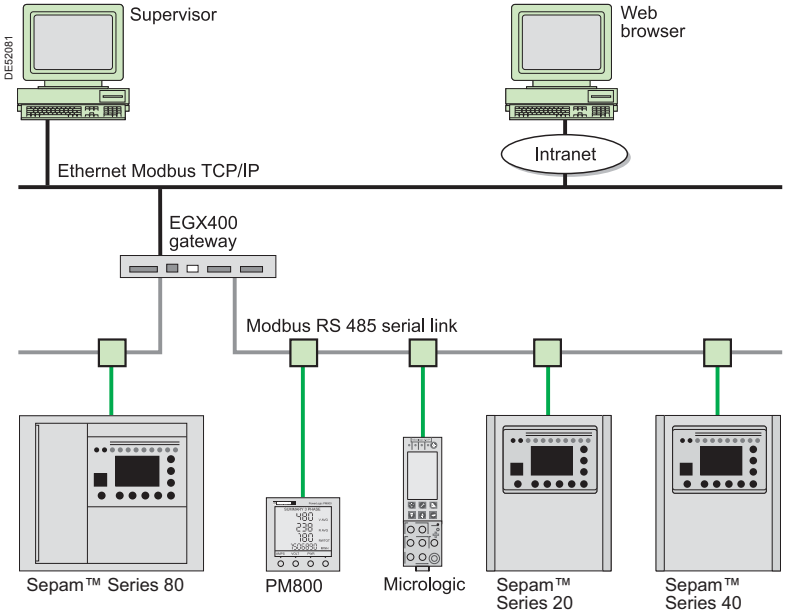
- supervision software
- a standard internet browser providing access to the main information organized in predefined HTML pages

These two approaches, supervisor and internet browser, are complementary:

- the supervisor offers complete access to all information, but requires specific software
- the HTML pages offer partial access to the main information via any PC connected to the network

Architecture

DE52081



Setup

Initial Setup

The initial setup is carried out using a PC connected to the EGX400 via an RS232 link. This setup:

- specifies the IP address of the EGX gateway
- selects the type of Ethernet port (wire or optic fiber)
- lists the connected products with their Modbus communication parameters

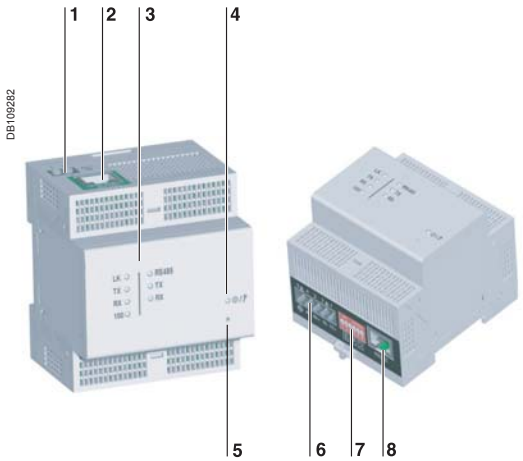
Setup via the Ethernet Network

Once connected to the Ethernet network, the EGX400 server can be accessed by a standard internet browser via its IP address to:

- create or update the list of the connected products with their Modbus communication parameters
- update the firmware

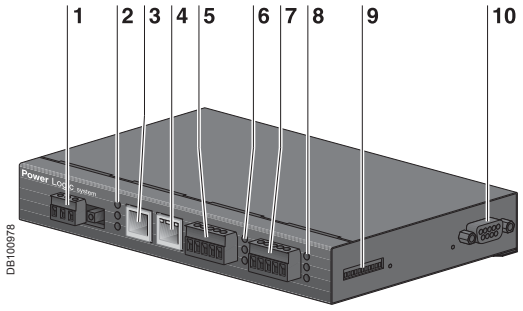
Ethernet EGX100 Gateway
Ethernet EGX400 Server

EGX100



1 *24 Vbc power connection.*
2 *10/100 Base TX (802.3af) port for connection to Ethernet via an RJ45 connector.*
3 *Ethernet and serial indication LEDs.*
4 *Power/Status LED.*
5 *Reset button.*
6 *RS485 connection.*
7 *Dip switches for biasing, termination, and 2-wire/4-wire jumpers.*
8 *RS232 connection.*

EGX400



1 *Power connector.*
2 *Ethernet indication LEDs.*
3 *10/100 Base TX port for connection to Ethernet via an RJ45 connector.*
4 *100 Base FX port for connection to Ethernet via fiber optic cable (LC connector).*
5 *COM1: terminal block for RS485 serial link.*
6 *COM1 indication LEDs.*
7 *COM2: terminal block for RS485 serial link.*
8 *COM2 indication LEDs.*
9 *Dip-switches for setup of COM1 and COM2 ports bias and termination.*
10 *COM2: Sub D-9 connector for the RS232 serial link.*

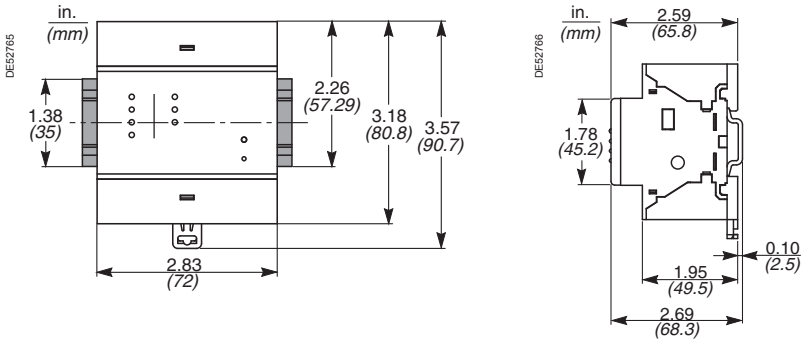
Characteristics

	EGX100	EGX400
Weight	6 oz (170 g)	24.7 oz (700 g)
Dimensions (H x W x D)	2.58 x 2.83 x 2.68 in (91 x 72 x 68 mm)	0.98 x 7.48 x 4.53 in. (25 x 190 x 115 mm)
Mounting	DIN rail	Symmetrical or asymmetrical DIN rail Front or side position
Power-over-Ethernet (PoE)	Class 3	None
Power supply	24 V DC if not using PoE	24 V DC 100-240 V AC/24 V DC adapter supplied
Operating temperature	-13 °F to 158 °F (-25 °C to +70°C)	-22 °F to 176 °F -30 °C to +80°C
Humidity rating	5 % to 95 % relative humidity (without condensation) at 131 °F (+55 °C)	5 % to 95 % relative humidity (without condensation) at 104 °F (+40 °C)
Regulatory/Standards Compliance for Electromagnetic Interference		
Emissions (radiated and conducted)	EN 55022/EN 55011/ FCC class A	EN 55022/FCC class A
Immunity for industrial environments:	EN 61000-6-2	EN 61000-6-2
- electrostatic discharge	EN 61000-4-2	EN 61000-4-2
- radiated RF	EN 61000-4-3	EN 61000-4-3
- electrical fast transients	EN 61000-4-4	EN 61000-4-4
- surge	EN 61000-4-5	EN 61000-4-5
- conducted RF	EN 61000-4-6	EN 61000-4-8
- power frequency magnetic field	EN 61000-4-8	EN 61000-4-11
Regulatory/Standards Compliance for Safety		
International (CB scheme)	IEC 60950	
USA	UL508/UL60950	UL508
Canada	cUL (complies with CSA C22.2, no. 60950)	cUL (complies with CSA C22.2, no. 14-M91)
Europe	EN 60950	
Australia/New Zealand	AS/NZS25 60950	
Serial Ports		
Number of ports	1	2
Types of ports	RS232 or RS485 (2-wire or 4-wire), depending on settings	COM1: RS485 (2-wire or 4-wire) COM2: RS232 or RS485 (2-wire or 4-wire), depending on settings
Protocol	Modbus RTU/ASCII PowerLogic® (SY/MAX)	Modbus RTU/ASCII PowerLogic® (SY/MAX)
Maximum baud rate	38400 or 57600 baud depending on settings	38400 baud
Maximum number of directly connected devices	32	32 per port, 64 in all
Ethernet Port		
Number of ports	1	2
Types of ports	One 10/100 base TX (802.3af) port	One 10/100 base TX port One 100 base FX port (multimode optic fiber)
Protocol	HTTP, SNMP, FTP, Modbus TCP/IP	HTTP, SNMP, SMTP, SNTP, FTP, Modbus TCP/IP
Baud rate	10/100 MB	10/100 MB
Web Server		
Memory for custom HTML pages	None	16 MB

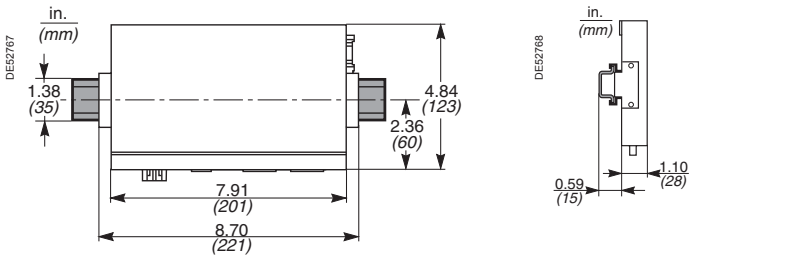
Ethernet EGX100 Gateway
Ethernet EGX400 Server

Installation

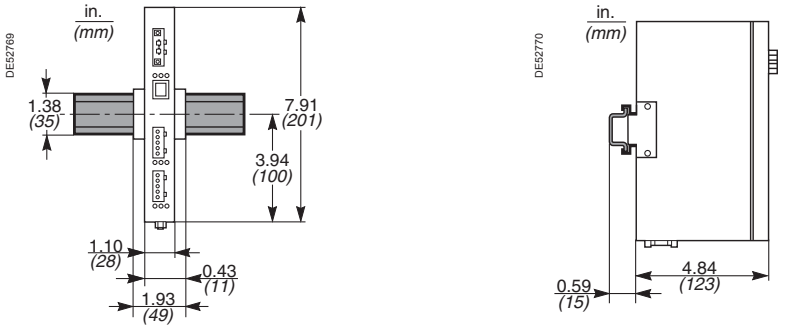
DIN Rail Mounting (EGX100)



Side Mounting on DIN Rail (EGX400)

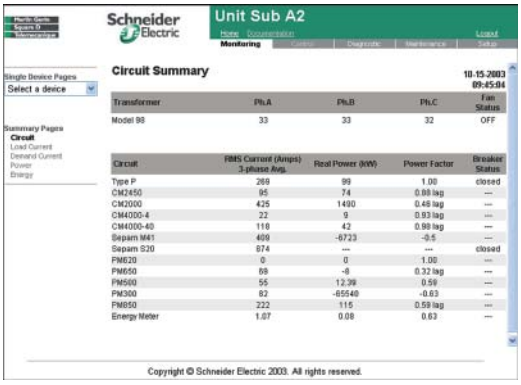


Front Mounting on DIN Rail (EGX400)



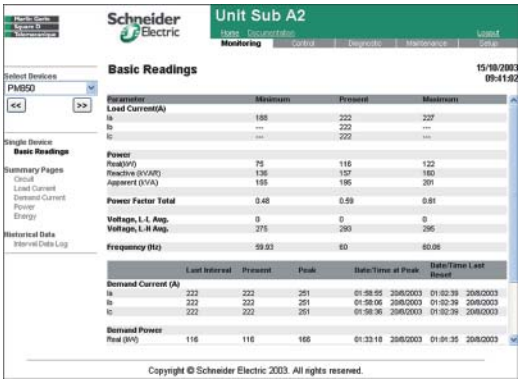
WPG Software Tool
HTML Page Generator

PE50271



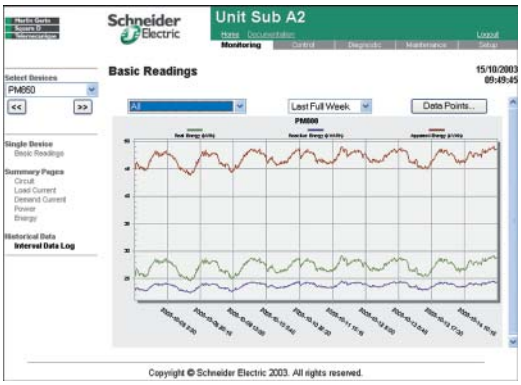
HTML page with summary information on all the equipment in a switchboard.

PE50272



Single device operating information HTML page.

PE50273



Single device HTML page showing historical data.

Function

Easy to use, the WPG software tool generates HTML pages for the EGX400 server. It is used to:

- select the devices connected to the server
- transfer the HTML pages corresponding to the selected devices to the server.

The WPG tool can set up HTML pages for the following devices:

- Sepam Series 20, Sepam Series 40, Sepam Series 80
- Masterpact™ equipped with Micrologic A, P and H control units
- Power Meter PM700 and PM800
- Circuit Monitor Series 2000, 3000 and 4000

The WPG software is available in English, French, and Spanish. To obtain WPG, contact your Schneider Electric representative.

HTML Pages

Following transfer, the EGX400 contains HTML pages that can be used to remotely monitor equipment under secure conditions.

- 1st service level based on the summary pages.
- 2nd service level based on specific pages for each type of device.

Summary Pages

Five summary pages are available for overall monitoring of the switchboard.
They present the main measurements input by the devices connected to the server.

- Page 1
  - 3-phase average rms current
  - active power
  - power factor
  - circuit-breaker position
- Page 2
  - rms current per phase
- Page 3
  - demand current per phase
- Page 4
  - demand power
  - maximum power
  - time-stamping data
- Page 5
  - active power
  - reactive power
  - date and time of last reset of energy meters

Specific Pages for each Device

A number of specific pages present detailed information on each device for in-depth analysis, such as:

- operating information:
  - instantaneous current per phase
  - demand current per phase
  - active and reactive power
  - average voltage (line-to-neutral and line-to-line)
  - maximum unbalance
  - power factor
  - frequency
- event information:
  - minimum and maximum current values
  - maximum demand current
  - date and time of last reset
- historical data:
  - recording over 38 days of three user-selectable parameters (energy by default), every 15, 30 or 60 minutes, with graphic display and data export to an Excel file

Selection Guide

Phase Current Sensors

Two types of sensor may be used with Sepam to measure phase current:
- 1 A or 5 A current transformers
- LPCT (Low Power Current Transducer) type current sensors

Selection Guide

1 A or 5 A current sensors are:
- sized case by case: accuracy, electrical characteristics, etc.
- defined according to the IEC 60044-1 standard

The LPCT type current sensors are:
- simple sizing: a given LPCT sensor is suitable for measuring different rated currents: for example, the CLP1 sensor measures rated currents of 25 to 1250 A
- defined according to IEC 60044-8 standard (rated secondary voltage = 22.5 mV)

Residual Current Sensors

The residual current value can be obtained from different sensors and assemblies chosen according to the performance required (measurement accuracy and ground fault protection sensitivity). Residual current can be:
- measured by a specific CSH120 or CSH200 zero sequence CT
- measured by a zero sequence CT with a ratio of 1/n (50 ≤ n ≤1500), with an ACE990 adapter.
- calculated by Sepam from the vector sum of the three phase currents

Selection Guide

Measurement Sensors	Recommended Minimum Set Point
CSH120 or CSH200 Zero Sequence CT connected to CCA634	> 1 A
1 or 3 x 1 A or 5 A CT+ CSH30	0.10 I_{N}CT (DT) 0.05 I_{N}CT (IDMT)
Zero Sequence CT + ACE990	0.10 I_{N}CT (DT) 0.05 I_{N}CT (IDMT)
3-Phase CT (Ir calculated by Sepam)	0.30 I_{N}CT (DT)(1) 0.10 I_{N}CT (IDMT)(1)

(1) *Recommended minimum set point for ANSI 50N/51N function with H2 restraint: 0.10 I_{N}CT (DT) or 0.05 I_{N}CT (IDMT).*

It is recommended not to set the ground fault protection functions below the recommended minimum set point. This avoids any risk of unwanted tripping caused by oversensitive detection of residual current or false residual current due to CT saturation. Lower settings may be used to trigger alarms.

Voltage Transformers

ANSI voltage transformer.

Function

Sepam can be connected to any standard voltage transformer with a rated secondary voltage of 100 V to 220 V. Schneider Electric offers a range of voltage transformers:

- to measure line-to-neutral voltages: voltage transformers with one insulated MV terminal
- to measure line-to-line voltages: voltage transformers with two insulated MV terminals
- with or without integrated protection fuses

Consult us for more information.

Connection

The voltage transformers connect to Sepam:

- directly, for Sepam Series 40 and Series 80
- or via the CCT640 connector for Sepam B21, B22 and the additional voltage inputs for Sepam B83

The table below presents the different connection possibilities for voltage transformers to Sepam.

	Sepam B21 and B22	**Sepam Series 40**	**Sepam Series 80**	
Number of voltage inputs	4	3	4 main	4 additional (1)
Intermediate connector	CCT640	-	-	CCT640
Sepam connector	B	E	E	B2

*(**1**) Sepam B83 only.*

When voltage transformers are connected directly to the E connector on Sepam, four transformers built into the Sepam base unit ensure matching and isolation between the VTs and the Sepam input circuits.

When voltage transformers are connected via the CCT640 connector, the four transformers for matching and isolation between the VTs and the Sepam input circuits are contained in the CCT640.

1A/5A Current Transformers

120R302

ANSI current transformer.

Function

Sepam can be connected to any standard 1A or 5A current transformer.
Schneider Electric offers a range of current transformers to measure primary currents from 50 A to 2500 A. Consult a representative for more information.

Sizing Current Transformers

Current transformers are sized so as not to be saturated by the current values they are required to measure accurately (minimum 5 In).

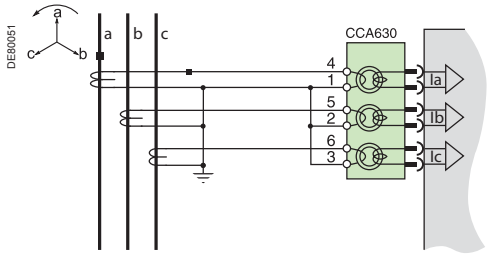
For Overcurrent Protection Functions

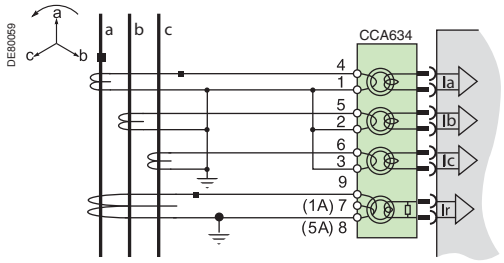
- with DT tripping curve: the saturation current must be 1.5 times greater than the setting
- with IDMT tripping curve: the saturation current must be 1.5 times greater than the highest working value on the curve.

Practical solution when there is no information on the settings

Rated Secondary Current (In)	Accuracy Burden	Accuracy Class	CT Secondary Resistance R_{CT}	Wiring Resistance R_f
1 A	2.5 VA	5P 20	< 3 Ω	< 0.075 Ω
5 A	7.5 VA	5P 20	< 0.2 Ω	< 0.075 Ω

1A/5A Current Transformers





CCA630/CCA634 Connector

Function

The current transformers (1 A or 5 A) are connected to the CCA630 or CCA634 connector on the rear panel of Sepam:

- The CCA630 connector is used to connect 3 phase current transformers to Sepam
- The CCA634 connector is used to connect 3 phase current transformers and a residual current transformer to Sepam

The CCA630 and CCA634 connectors contain interposing ring CTs with through primaries, which ensure impedance matching and isolation between the 1A or 5A circuits and Sepam when measuring phase and residual currents. The connectors can be disconnected with the power on since disconnection does not open the CT secondary circuit.

⚠ DANGER

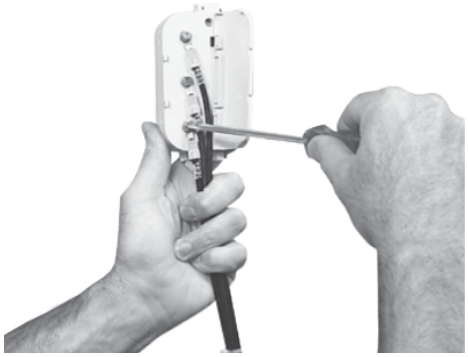
HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. In the USA, see NFPA 70E
- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device
- NEVER work alone.
- Before performing visual inspections, tests, or maintenance of this equipment, disconnect all sources of electric power. Assume all circuits are live until they have been completely de-energized, tested, and tagged. Pay particular attention to the design of the power system. Consider all sources of power, including the possibility of backfeeding
- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding
- Always use a properly rated voltage sensing device to confirm that all power is off
- To remove current inputs to the Sepam unit, unplug the CCA630 or CCA634 connector without disconnecting the wires from it. The CCA630 and CCA634 connectors ensure continuity of the current transformer secondary circuits
- Before disconnecting the wires connected to the CCA630 or CCA634 connector, short-circuit the current transformer secondary circuits

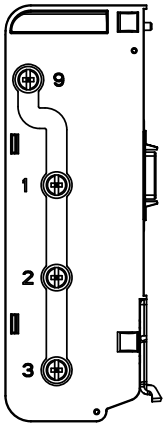
Failure to follow these instructions will result in death or serious injury.

1A/5A Current Transformers

MT10490

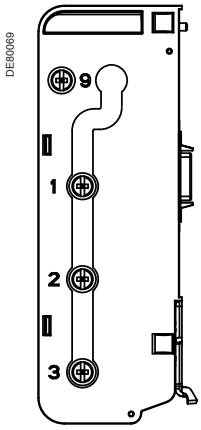


DE80068



Bridging of terminals 1, 2, 3 and 9

DE80069



Bridging of terminals 1, 2 and 3

Connecting and Assembling the CCA630 Connector

1. Open the two side shields for access to the connection terminals. The shields can be removed, if necessary, to make wiring easier. If removed, they must be replaced after wiring.
2. If necessary, remove the bridging strap linking terminals 1, 2 and 3. This strap is supplied with the CCA630.
3. Connect the wires using 0.16 in (4 mm) ring lugs and check the tightness of the six screws that guarantee the continuity of the CT secondary circuits.
   The connector accommodates wires with cross-sections of AWG 16-10 (1.5 to 6 mm²).
4. Close the side shields.
5. Plug the connector into the 9-pin inlet on the rear panel (item Ⓑ).
6. Tighten the two CCA630 connector fastening screws on the Sepam rear panel.

Connecting and Assembling the CCA634 Connector

1. Open the two side shields for access to the connection terminals. The shields can be removed, if necessary, to make wiring easier. If removed, they must be replaced after wiring.
2. According to the wiring required, remove or reverse the bridging strap. This is used to link either terminals 1, 2 and 3, or terminals 1, 2, 3 and 9 (see picture opposite).
3. Use terminal 7 (1 A) or 8 (5 A) to measure the residual current according to the CT secondary.
4. Connect the wires using 0.16 in (4 mm) ring lugs and check the tightness of the six screws that ensure the continuity of the CT secondary circuits.
   The connector accommodates wires with cross-sections of AWG 16-10 (1.5 to 6 mm²). The wires only exit from the base.
5. Close the side shields.
6. Insert the connector pins into the slots on the base unit.
7. Flatten the connector against the unit to plug it into the 9-pin SUB-D connector (principle similar to that of the MES module).
8. Tighten the mounting screw.

CAUTION

HAZARD OF IMPROPER OPERATION

Sepam Series 20, Sepam Series 40

- Do not connect the connector A residual current input Ir (terminals 18 and 19) and the CCA634 residual current input (terminal 9 and 7 or 8) simultaneously.

These two residual current input use the same Sepam analog channel.

Sepam Series 80

- Do not use a CCA634 on connector B1 and residual current input Ir on connector E (terminals 14 and 15) simultaneously.

Even if it is unconnected to a sensor, a CCA634 on connector B1 will disturb input Ir on connector **E**.

- Do not use a CCA634 on connector B2 and residual current input I'r on connector E (terminals 17 and 18) simultaneously

- Even if it is not connected to a sensor, a CCA634 on connector B2 will disturb input I'r on connector **E**.

Failure to follow this instruction can cause equipment damage.

LPCT Type Current Sensors

PE50031

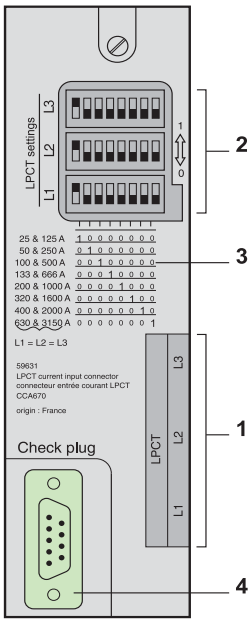
CLP1 LPCT sensor

Function

Low Power Current Transducer (LPCT) type sensors are voltage-output sensors, which are compliant with the IEC 60044-8 standard.

The Schneider Electric range of LPCTs includes the following sensors: CLP1, CLP2, CLP3, TLP160 and TLP190.

DE51674



CCA670/CCA671 Connector

Function

The three LPCT sensors are connected to the CCA670 or CCA671 connector on the rear panel of Sepam.
Connecting fewer than three LPCT sensors is not allowed and causes Sepam to go into fail-safe position.
The two CCA670 and CCA671 interface connectors serve the same purpose, the difference being the position of the LPCT sensor plugs:

- CCA670: lateral plugs, for Sepam Series 20 and Series 40
- CCA671: radial plugs, for Sepam Series 80

Description

1 Three RJ45 plugs to connect the LPCT sensors.
2 Three blocks of microswitches to set the CCA670/CCA671 to the rated phase current value.
3 Microswitch setting/selected rated current equivalency table (2 IN values per position).
4 9-pin sub-D connector to connect test equipment (ACE917 for direct connector or via CCA613).

Rating of CCA670/CCA671 Connectors

The CCA670/CCA671 connector must be rated according to the rated primary current IN measured by the LPCT sensors. IN is the current value that corresponds to the rated secondary current of 22.5 mV. The possible settings for IN are (in A): 25, 50, 100, 125, 133, 200, 250, 320, 400, 500, 630, 666, 1000, 1600, 2000, 3150.
The selected IN value should be:

- entered as a Sepam general setting
- configured by microswitch on the CCA670/CCA671 connector

Operating Mode:

1. Use a screwdriver to remove the shield located in the “LPCT settings” zone; the shield protects three blocks of eight microswitches marked L1, L2, L3.
2. On the L1 block, set the microswitch for the selected rated current to “1” (2 IN values per microswitch).
   - The table of equivalencies between the microswitch settings and the selected rated current IN is printed on the connector
   - Leave the seven other microswitches set to “0”.
3. Set the other two blocks of switches L2 and L3 to the same position as the L1 block and close the shield.

CAUTION

HAZARD OF NON-OPERATION

- Set the microswitches for the CCA670/ CCA671 connector before commissioning the device.
- Check that only one microswitch is in position 1 for each block L1, L2, L3 and that no microswitch is in the center position.
- Check that the microswitch settings on all 3 blocks are identical.

Failure to follow these instructions can cause incorrect operation.

LPCT Type Current Sensors
Test Accessories

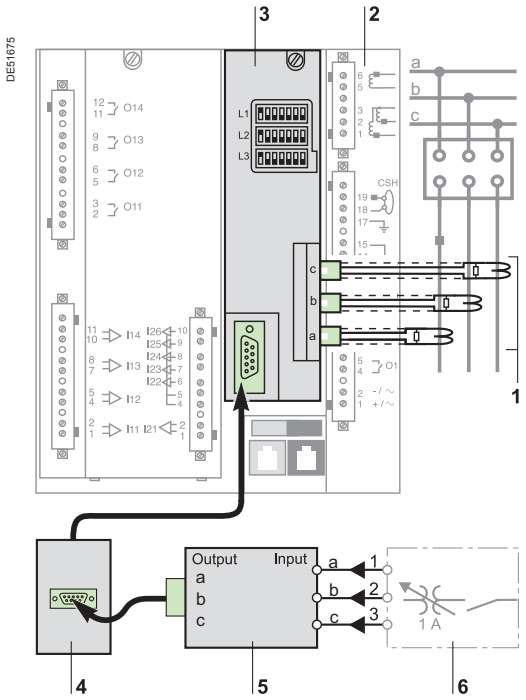
Accessory Connection Principle

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions.
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding.
- Always use a properly rated voltage sensing device to confirm that all power is off.

Failure to follow these instructions will result in death or serious injury.



1 LPCT sensor, equipped with a shielded cable fitted with a yellow RJ 45 plug which is plugged directly into the CCA670/CCA671 connector.

2 Sepam protection unit.

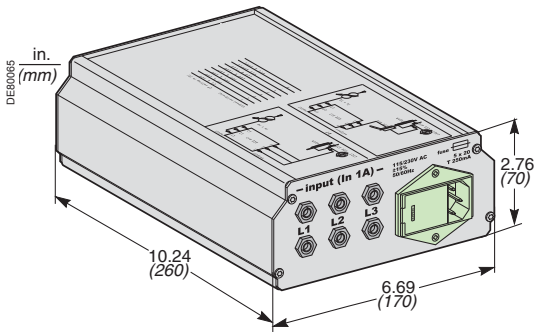
3 CCA670/CCA671 connector, LPCT voltage interface, with microswitch setting of rated current:
- CCA670: lateral plugs for Sepam Series 20 and Series 40
- CCA671: radial plugs for Sepam Series 80

4 CCA613 remote test plug, flush-mounted on the front of the cubicle and equipped with a 9.84 ft (3-meter) cable to be plugged into the test plug of the CCA670/CCA671 interface connector (9-pin sub-D).

5 ACE917 injection adapter, to test the LPCT protection chain with a standard injection box.

6 Standard injection box.

LPCT Type Current Sensors
Test Accessories



ACE917 Injection Adapter

Function

The ACE917 adapter is used to test the protection chain with a standard injection box, when Sepam is connected to LPCT sensors. The ACE917 adapter is inserted between:

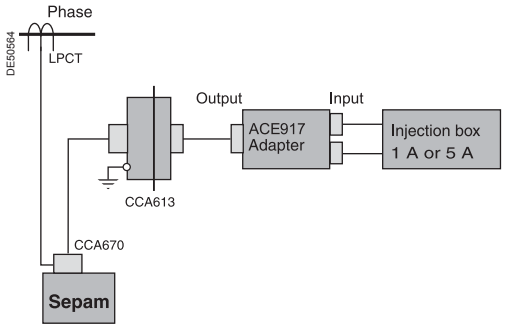
- The standard injection box
- The LPCT test plug:
  - integrated in the Sepam CCA670/CCA671 interface connector
  - or transferred by means of the CCA613 accessory

The following are supplied with the ACE917 injection adapter:

- Power supply cable
- 9.84 ft (3-meter) cable to connect the ACE917 to the LPCT test plug on CCA670/CCA671 or CCA613.

Characteristics

Power supply	115/230 V AC
Protection by time-delayed fuse 5 mm x 20 mm (0.2 x 0.79 in)	0.25 A rating



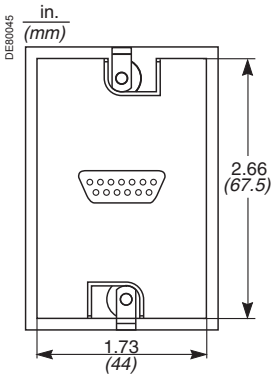
Accessory connection principle

CCA613 Remote Test Plug

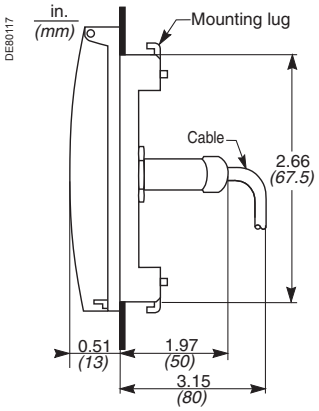
Function

The CCA613 test plug, flush-mounted on the front of the cubicle, is equipped with a 9.84 ft (3-meter) cable to transfer data from the test plug integrated in the CCA670/CCA671 interface connector on the rear panel of Sepam.

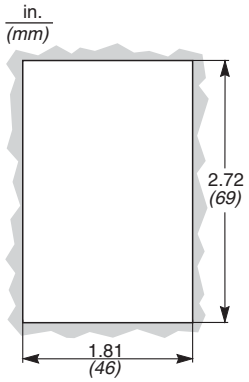
Dimensions



Front view with cover lifted



Right side view



Cut-out

CSH120 and CSH200 Zero Sequence CTs

PE50032

CSH120 and CSH200 zero sequence CTs.

Function

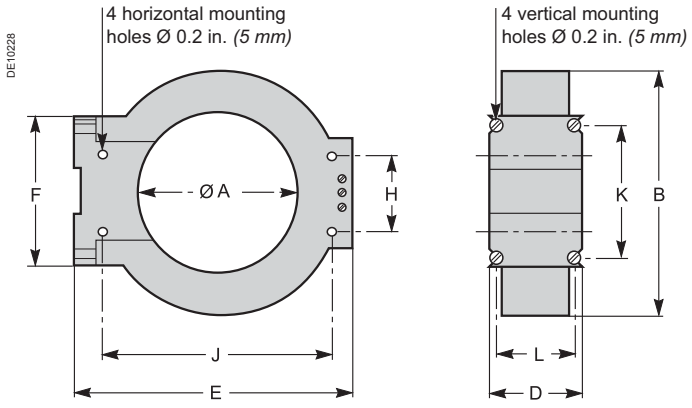
The specifically designed CSH120 and CSH200 zero sequence CTs are for direct residual current measurement. The only difference between them is the diameter. Due to their low voltage insulation, they can only be used on cables.

Characteristics

	CSH120	CSH200
Inner diameter	4.7 in (120 mm)	7.9 in (200 mm)
Weight	1.32 lb (0.6 kg)	3.09 lb (1.4 kg)
Accuracy	±5% at 68°F (20°C)	
	±6% max. from -13°F to +158°F (-25°C to 70°C)	
Transformation ratio	1/470	
Maximum permissible current	20 kA - 1 s	
Operating temperature	-13°F to +158°F (-25°C to +70°C)	
Storage temperature	-40°F to +185°F (-40°C to +85°C)	

Dimensions

DE10228



Dimensions	A	B	D	E	F	H	J	K	L
CSH120 (in)	4.75	6.46	1.73	7.48	2.99	1.57	6.54	2.44	1.38
(mm)	(120)	(164)	(44)	(190)	(76)	(40)	(166)	(62)	(35)
CSH200 (in)	7.87	10.1	1.81	10.8	4,72	2.36	10.1	4.09	1.46
(mm)	(200)	(256)	(46)	(274)	(120)	(60)	(257)	(104)	(37)

CSH120 and CSH200 Zero Sequence CTs

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, EXPLOSION OR ARC FLASH

- Only qualified personnel should install this equipment. Such work should be performed only after reading this entire set of instructions and checking the technical characteristics of the device.
- NEVER work alone.
- Turn off all power supplying this equipment before working on or inside it. Consider all sources of power, including the possibility of backfeeding.
- Always use a properly rated voltage sensing device to confirm that all power is off.
- Only CSH120, CSH200 and CSH280 zero sequence CTs can be used for direct residual current measurement. Other residual current sensors require the use of an intermediate device, CSH30, ACE990 or CCA634.
- Install the zero sequence CTs on insulated cables.
- Cables with a rated voltage of more than 1000 V must also have a grounded shielding.

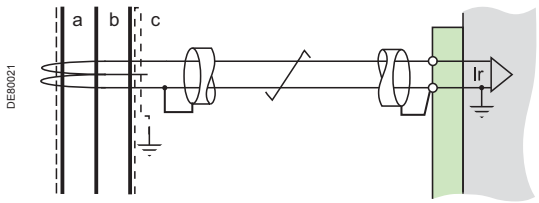
Failure to follow these instructions will result in death or serious injury.

CAUTION

HAZARD OF NON-OPERATION

Do not connect the secondary circuit of the CSH zero sequence CTs to ground.
This connection is made in Sepam.

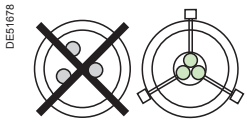
Failure to follow this instruction can cause Sepam to operate incorrectly.



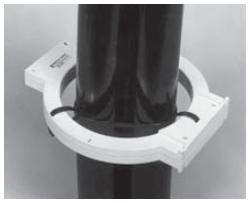
DE80021

Assembly

Group the MV cable (or cables) in the middle of the zero sequence CT. Use non-conductive binding to hold the cables. Remember to insert the 3 medium voltage cable shielding grounding cables through the zero sequence CT. See below.



DE51678



E40465

Assembly on MV cables.

Connection

Connection to Sepam Series 20 and Series 40

To residual current Ir input, on connector (A), terminals 19 and 18 (shielding).

Connection to Sepam Series 80

- To residual current Ir input, on connector (E), terminals 15 and 14 (shielding)
- To residual current I'r input, on connector (E), terminals 18 and 17 (shielding).

Recommended cable

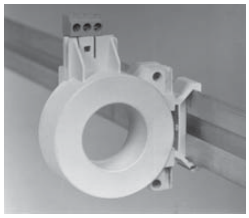
- Sheathed cable, shielded by tinned copper braid
- Minimum cable cross-section AWG 18 (0.93 mm²)
- Resistance per unit length < 30.5 mΩ/ft (100 mΩ/m)
- Minimum dielectric strength: 1000 V (700 Vrms)
- Connect the cable shielding in the shortest manner possible to Sepam
- Flatten the connection cable against the metal frames of the cubicle

The connection cable shielding is grounded in Sepam. Do not ground the cable by any other means.

The maximum resistance of the Sepam connection wiring must not exceed 4 Ω (66 ft maximum for 30.5 mΩ/ft or 20 m maximum for 100 mΩ/m).

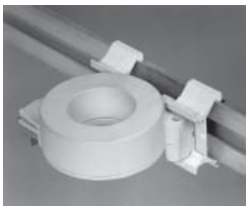
CSH30
Interposing Ring CT

E40468



Vertical assembly of CSH30 interposing ring CT.

E44717



Horizontal assembly of CSH30 interposing ring CT.

Function

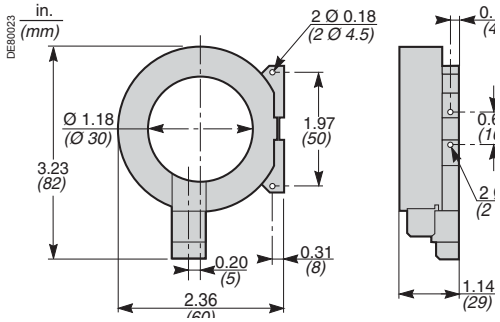
The CSH30 interposing ring CT is used as an interface when the residual current is measured using 1 A or 5 A current transformers.

Characteristics

Weight	0.265 lb (0.12 kg)
Assembly	On symmetrical DIN rail In vertical or horizontal position

Dimensions

DE80023

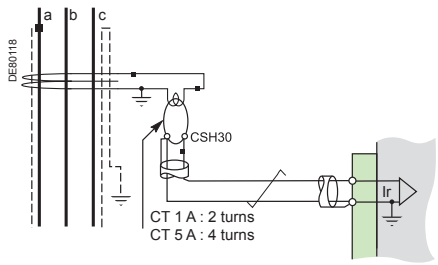


Connection

The CSH30 is adapted for the type of current transformer, 1 A or 5 A, by the number of turns of the secondary wiring through the CSH30 interposing ring CT:

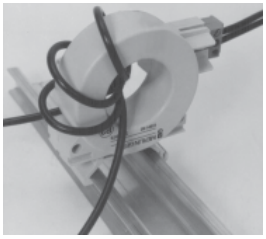
- 5 A rating - 4 turns
- 1 A rating - 2 turns

DE80118



Connection to 5 A Secondary Circuit

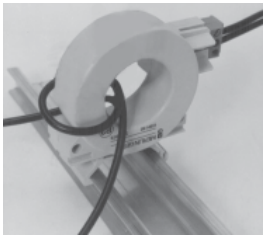
PE50033



1. Plug into the connector.
2. Insert the transformer secondary wire through the CSH30 interposing ring CT four times.

Connection to 1 A Secondary Circuit

PE50034



1. Plug into the connector.
2. Insert the transformer secondary wire through the CSH30 interposing ring CT twice.

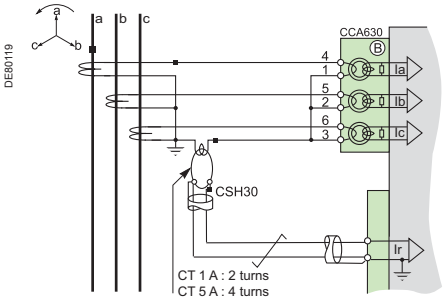
Connecting to Sepam Series 20 and Series 40

To residual current Ir input, on connector (A), terminals 19 and 18 (shielding).

Connection to Sepam Series 80

- To residual current Ir input, on connector (E), terminals 15 and 14 (shielding)
- To residual current I'r input, on connector (E), terminals 18 and 17 (shielding).

DE80119



Recommended Cable

- Sheathed cable, shielded by tinned copper braid
- Minimum cable cross-section AWG 18 (0.93 mm²) (max. AWG 12, 2.5 mm²)
- Resistance per unit length < 30.5 mΩ/ft (100 mΩ/m)
- Minimum dielectric strength: 1000 V (700 Vrms)
- Maximum length: 6.6 ft (2 m).

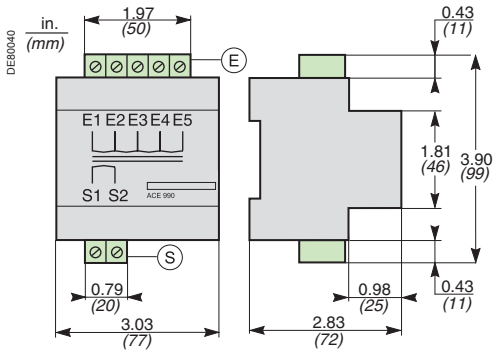
It is essential to install the CSH30 interposing ring CT near Sepam, because the Sepam - CSH30 link is less than 6.6 ft (2 m) long. Flatten the connection cable against the metal frames of the cubicle. The connection cable shielding is grounded in Sepam. Do not ground the cable by any other means.

ACE990
Zero Sequence CT Interface

PE50037

ACE990 zero sequence CT interface

DE80040



Function

The ACE990 is used to adapt measurements between an MV zero sequence CT with a ratio of 1/n (50 ≤ n ≤ 1500), and the Sepam residual current input.

Characteristics

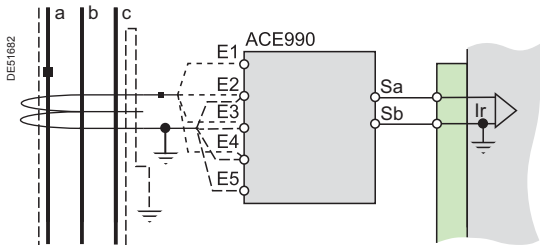
Weight	1.41 lb (0.64 kg)
Assembly	Mounted on symmetrical DIN rail
Amplitude accuracy	±1%
Phase accuracy	< 2°
Maximum permissible current	20 kA - 1 s (on the primary winding of an MV zero sequence CT with a ratio of 1/50 that does not saturate)
Operating temperature	+23°F to +131°F (-5°C to +55°C)
Storage temperature	-13°F to +158°F (-25°C to +70°C)

Description and Dimensions

(E) ACE990 input terminal block, for connection of the zero sequence CT.

(S) ACE990 output terminal block, for connection of the Sepam residual current.

ACE990
Zero Sequence CT Interface



Connection

Connecting a Zero Sequence CT

Only one zero sequence CT can be connected to the ACE990 interface. The secondary circuit of the MV zero sequence CT is connected to two of the five ACE990 interface input terminals. To define the two input terminals, it is necessary to know the following:

- Zero sequence CT ratio (1/n)
- Zero sequence CT power
- Close approximation of rated current Inr
  (Inr is a general setting in Sepam and defines the ground fault protection setting range between 0.1 Inr and 15 Inr).

The table below can be used to determine:

- The two ACE990 input terminals to be connected to the MV zero sequence CT secondary
- The type of residual current sensor to set
- The exact value of the rated residual current Inr setting, given by the following formula: **Inr = k x number of zero sequence CT turns**
  with k the factor defined in the table below.

The zero sequence CT must be connected to the interface in the right direction for correct operation: the MV zero sequence CT secondary output terminal S1 must be connected to the terminal with the lowest index (Ex).

K Value	ACE990 Input Terminals to be Connected	Residual Current Sensor Setting	Min. MV Zero Sequence CT Power
0.00578	E1 - E5	ACE990 - range 1	0.1 VA
0.00676	E2 - E5	ACE990 - range 1	0.1 VA
0.00885	E1 - E4	ACE990 - range 1	0.1 VA
0.00909	E3 - E5	ACE990 - range 1	0.1 VA
0.01136	**E2 - E4**	**ACE990 - range 1**	**0.1 VA**
0.01587	E1 - E3	ACE990 - range 1	0.1 VA
0.01667	E4 - E5	ACE990 - range 1	0.1 VA
0.02000	E3 - E4	ACE990 - range 1	0.1 VA
0.02632	E2 - E3	ACE990 - range 1	0.1 VA
0.04000	E1 - E2	ACE990 - range 1	0.2 VA
0.05780	E1 - E5	ACE990 - range 2	2.5 VA
0.06757	E2 - E5	ACE990 - range 2	2.5 VA
0.08850	E1 - E4	ACE990 - range 2	3.0 VA
0.09091	E3 - E5	ACE990 - range 2	3.0 VA
0.11364	E2 - E4	ACE990 - range 2	3.0 VA
0.15873	E1 - E3	ACE990 - range 2	4.5 VA
0.16667	E4 - E5	ACE990 - range 2	4.5 VA
0.20000	E3 - E4	ACE990 - range 2	5.5 VA
0.26316	E2 - E3	ACE990 - range 2	7.5 VA

Example:

Given a zero sequence CT with a ratio of 1/400 2 VA, used within a measurement range of 0.5 A to 60 A.
How should it be connected to Sepam via the ACE990?
1. Choose a close approximation of the rated current Inr (5 A).
2. Calculate the ratio:
approx. Inr/number of turns = 5/400 = 0.0125.
3. Find the closest value of k in the table opposite to k = 0.01136.
4. Check the minimum power required for the zero sequence CT: 2 VA zero sequence CT > 0.1 VA V OK.
5. Connect the zero sequence CT secondary to ACE990 input terminals E2 and E4.
6. Set Sepam up with:
Inr = 0.01136 x 400 = 4.5 A.

This value of Inr can be used to monitor current between 0.45 A and 67.5 A.

Wiring the MV zero sequence CT secondary circuit:

- *S1 output to ACE990 E2 input terminal*
- *S2 output to ACE990 E4 input terminal.*

Connection to Sepam Series 20 and Sepam Series 40

To residual current Ir input, on connector (A), terminals 19 and 18 (shielding).

Connection to Sepam Series 80

- To residual current Ir input, on connector (E), terminals 15 and 14 (shielding)
- To residual current I'r input, on connector (E), terminals 18 and 17 (shielding).

Recommended Cables

- Cable between zero sequence CT and ACE990: less than 160 ft (50 m) long
- Sheathed cable, shielded by tinned copper braid between the ACE990 and Sepam, maximum length 6.6 ft (2 m)
- Cable cross-section between AWG 18 (0.93 mm²) and AWG 12 (2.5 mm²)
- Resistance per unit length less than 30.5 mΩ/ft (100 mΩ/m)
- Minimum dielectric strength: 100 Vrms

Connect the connection cable shielding in the shortest manner possible (5.08 in or 2 cm maximum) to the shielding terminal on the Sepam connector.
Flatten the connection cable against the metal frames of the cubicle.
The connection cable shielding is grounded in Sepam. Do not ground the cable by any other means.

Ordering Sepam Relays

Digital Protective Relay **196**
Selection Table **197**
Application and Accessory Lists **198**
Selection Example **199**

Sepam Series 20, 40, and 80
Digital Protective Relay

20, 40, and 80 Series

The Sepam family of digital protection units, Series 20, 40 and 80, is the newest generation of Sepam relay, a time tested product with a 20-year worldwide history. Modular relay design allows quick and easy future upgrades to communications, digital I/O, analog output or temperature acquisition. The 64x128 bit, graphic LCD display and keypad permit basic relay setting of Series 20 and 40 without a PC. Comprehensive self-testing provides assurance of readiness to protect. The Sepam family also has exceptional withstand to environmental electromagnetic disturbances. An optional 128 x 240 LCD display can show one-line or electrical vectors.

Table 1: Quick Select Guide

Criteria	Selection	Feeder or main (Substation)	Transformer	Motor	Generator	Bus	Capacitor Bank
Network structure	Radial (51, 51N, 46)	S23	T23	M20	G40	B80	C86
	Long feeders (67N)	S41		M41			
	Closed loop (67N, 67)	S42					
	Parallel mains [transf] [sources] (67N, 67)	S42	T42		G82		
	Sync-check required (25)(67N, 67)	S82	T82		G82	B80	
Grounding system	Solid or low/high impedance (51N)	S23	T23	M20	G40		
	Ungrounded or compensated (67N/NC)	S41	T42	M41	G82		
Protection	Basic Feeder [Transf][Motor]	S23	T23	M20	G40		
	Voltage/frequency (27/59/81)	S40	T40	M41	G40	B21	
	ROCOF (81R)	S84				B22	
	Advanced Fdr/Main[Transf] [Motor][Gen]	S41	T82	M81	G82	B83	
	Thermal overload (49)-cable	S81					
	Thermal O/L (49)- capacitor bank						C86
	Differential (87T)		T87				
	Machine differential (87M)			M87	G87		
	Machine-transformer unit differential			M88	G88		
Metering	I	S23	T23	M20			
	V, f					B21	
	I, V, f, P, E	S40	T40	M41	G40	B80	
	I, V, V, f, P, E					B83	
	I, I, V, F, P, E		T87	M87	G87		
	THD-I, THD-V	S80	T81	M81	G82	B80	
Temperature	<8 RTDs of same type		T23	M20	G40		
	> 8 RTDs (< 16) or 2 types of RTDs		T40	M41	G40		
I/Os	< 10 I / 8 O	S23	T23	M20	G40	B21	
	> 10 I / 8 O and < 42 I / 23 O	S80	T81	M81	G82	B80	
Program logic customization	Control matrix	S23	T23	M20	G40	B21	
	Logic equation editor	S40	T40	M41	G40	B80	
	Ladder-logic software	S80	T81	M81	G82	B80	
Modbus communication	1 Modbus port	S23	T23	M20	G40	B21	
	2 Modbus ports	S80	T81	M81	G82	B80	

Note: Units in table depict least complex device types compliant with criterion.

Sepam Series 20 Relay Features

- Backlit LCD graphic bitmap display
- Compact standard footprint (< 4”deep) for basic protection of Mains/Feeders, Transformer, Motor, Bus (Voltage) Applications
- 16 inverse time overcurrent characteristic curves
- Setting software with offline file creation and download to relay
- Two 86 cycle records of fault recording, last trip fault values, and last 64 time-tagged alarms retained
- Provides trip diagnostic information for analysis of faults
- Self-test diagnostic ensures correct operation of relay and integrity of protection
- Wide range of control power inputs
- Display operation minimal training required for operation.
- Application specific design for Main/Feeder, Transformer, Motor, Bus (Voltage) zones
- Zone selective interlocking (ZSI) improved protection coordination
- Rear communication port for interface to optional Modbus communications modules, plus dual port module, opt protocols DNP3 and IEC60870-5-103, and also F/O
- Modular architecture
- Breaker diagnostics

Sepam Series 40 Relay Features

- Compact standard footprint (< 4”deep) for enhanced protection of Mains/Feeders, Transformer, Motor, Generator Applications
- Directional overcurrent protection for dual mains and ties and closed loop feeders
- Current and voltage inputs I, V, E, P, PF
- Setting software with Boolean logic equation assistance
- CT/VT and Trip Circuit supervision
- Sixteen seconds of fault recording, last 5 trip reports, and last 200 time-tagged alarms
- Rear communication port for interface to optional Modbus® communications modules
- Includes all Series 20 features

Sepam Series 80 Relay Features

- Standard footprint for enhanced protection of Mains/Feeders, Transformer, Motor, Generator, Capacitor, Bus Applications
- Differential protection of transformer or machine transformer units
- Differential protection of motors and generators
- Protection for mains and ties and important feeders including pre-programmed transfer schemes
- Increased metering capabilities I, V, E, P, PF, THD, vector diagram
- Expanded logic equation capabilities (an option for Logipam PLC ladder logic)
- Setting software with graphical assistance, opt mimic-based display
- Battery backup for historical and fault waveform data retention, wide range DC control power
- Two rear communication interfaces
- Includes all Series 20 and Series 40 features

Sepam Series 20, 40, and 80
Selection Table

Table 2: Series 20/40 Applications

Protection	Application ANSI Code	S23	S40	S41	S42	T23	T40	T42	M20	M41	G40	B21	B22
Phase overcurrenta	50/51	4	4	4	4	4	4	4	4	4	4		
Voltage-restrained overcurrent	50V/51V										1		
Ground fault / Sensitive ground faulta	50N/51N 50G/51G	4	4	4	4	4	4	4	4	4	4		
Breaker failure	50BF	1	1	1	1	1	1	1		1	1		
Negative sequence / unbalance	46	1	2	2	2	1	2	2	1	2	2		
Directional phase overcurrenta	67				2			2					
Directional ground faulta	67N/67NC			2	2			2		2			
Directional active overpower	32P			1	1					1	1		
Directional reactive overpower	32Q/40									1	1		
Thermal overloada	49RMS					2	2	2	2	2	2		
Phase undercurrent	37								1	1			
Excessive starting time, locked rotor	48/51LR/14								1	1			
Starts per hour	66								1	1			
Positive sequence undervoltage	27D/47											2	2
Positive sequence undervoltage	27D									2			
Remanent undervoltage	27R									1		1	1
Phase-to-phase undervoltage	27											2	2
Phase-to-neutral undervoltage	27S											1	1
Undervoltagec	27/27S		2	2	2		2	2		2	2		
Overvoltagec	59		2	2	2		2	2		2	2	2	2
Neutral voltage displacement	59N		2	2	2		2	2		2	2	2	2
Negative sequence overvoltage	47		1	1	1		1	1		1	1		
Overfrequency	81H		2	2	2		2	2		2	2	1	1
Underfrequency	81L		4	4	4		4	4		4	4	2	2
Rate of change of frequency	81R												1
Recloser (4 cycles)	79	e	e	e	e								
Temperature monitoring (8 or 16 RTDs)	38/49T					e	e	e	e	e	e		
Thermostat / Buchholz	26/63					e	e	e					

Note: Numerals in table indicate number of protection setpoints

a Protection functions with 2 groups of settings
b Requires MES120 I/O module
c Requires MET1482 RTD Input module
d Requires MCS025 synch check module
e Option

Table 3: Series 80 Applications

Protection	Application ANSI Code	S80	S81	S82	S84	T81	T82	T87	M81	M87	M88	G82	G87	G88	B80	B83	C86
Phase overcurrenta	50/51	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Ground fault / Sensitive ground faulta	50N/51N 50G/51G	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
Breaker failure	50BF	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Negative sequence / unbalance	46	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Thermal overload for cables	49RMS		2	2	2												
Thermal overload for machinesa	49RMS					2	2	2	2	2	2	2	2	2			
Thermal overload for capacitors	49RMS																2
Capacitor bank unbalance	51C																8
Restricted ground fault	64REF					2	2	2				2		2			
Two-winding transformer differential	87T							1			1			1			
Machine differential	87M									1			1				
Directional phase overcurrenta	67			2	2		2	2				2	2	2			
Directional ground faulta	67N/67NC		2	2	2	2	2	2	2	2	2	2	2	2			
Directional active overpower	32P		2	2	2	2	2	2	2	2	2	2	2	2			
Directional reactive overpower	32Q								1	1	1	1	1	1			
Directional active underpower	37P				2							2					
Phase undercurrent	37								1	1	1						
Excessive starting time, locked rotor	48/51LR								1	1	1						
Starts per hour	66								1	1	1						
Field loss (underimpedance)	40								1	1	1	1	1	1			
Pole slip	78PS								1	1	1	1	1	1			
Overspeed (2 set points)b	12								e	e	e	e	e	e			
Underspeed (2 set points)b	14								e	e	e	e	e	e			
Voltage-restrained overcurrent	50V/51V											2	2	2			
Underimpedance	21B											1	1	1			
Inadvertent energization	50/27											1	1	1			
Third harmonic undervoltage/100% stator ground fault	27TN/64G2/64G											2	2	2			
Overfluxing (V / Hz)	24							2				2	2	2			
Positive sequence undervoltage	27D	2	2	2	4	2	2	2	2	2	2	2	2	2	4	4	4
Remanent undervoltage	27R	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Undervoltage (L-L or L-N)	27	4	4	4	2	4	4	4	4	4	4	4	4	4	2	2	2
Overvoltage (L-L or L-N)	59	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Neutral voltage displacement	59N	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Negative sequence overvoltage	47	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Overfrequency	81H	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Underfrequency	81L	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
Rate of change of frequency	81R				2												
Recloser (4 cycles)b	79	e	e	e	e												
Thermostat / Buchholzb	26/63					e	e	e	e		e	e		e			
Temperature monitoring (16 RTDs)c	38/49T					e	e	e	e	e	e	e	e	e			e
Synchronism-checkd	25	e	e	e	e	e	e	e				e	e	e	e	e	

Table 4: Application List by Catalog Number

Model	Application	Catalog No.	Model	Application	Catalog No.
Series 80	S80 - Substation/feeder [current & voltage]	SQ1S80Aa	Series 40	S40 - Substation/feeder [current & voltage]	SQ1S40A
	S81 - Substation/feeder [directional grd O/C]	SQ1S81A		S41 - Substation/feeder [directional grd O/C]	SQ1S41A
	S82 - Substation/feeder [directional ph & grd O/C]	SQ1S82A		S42 - Substation/feeder [directional ph & grd O/C]	SQ1S42A
	S84 - Substation/main [separation/ load shed]	SQ1S84A		T40 - Transformer [current & voltage]	SQ T40A
	T81 - Transformer [current & voltage]	SQ1T81A		T42 - Transformer [Dir. Ph & Grd O/C]	SQ1T42A
	T82 - Transformer [Dir. Ph & Grd O/C]	SQ1T82A		M41 - Motor [Dir. Grd O/C]	SQ1M41A
	T87 - Transformer [Diff.-2 wdg)	SQ1T87A		G40 - Generator [Dir. Real & Reac Power, Volt-Restr O/C]	SQ1G40A
	M81- Motor [Dir. Grd O/C]	SQ1M81A			
	M87- Motor [Mach. Diff.]	SQ1M87A	Series 20	S23 - Substation/feeder [breaker failure]	SQ1S23A
	M88 - Motor [Transf. Diff.]	SQ1M88A		T23 - Transformer [breaker failure]	SQ1T23A
	G82 - Generator [Dir. Watt & Var, Volt-Restr O/C]	SQ1G82A		M20 - Motor	SQ1M20A
	G87 - Generator [Mach diff]	SQ1G87A		B21 - Bus (Voltage/Freq)	SQ1B21A
	G88 - Generator [Transf diff]	SQ1G88A		B22 - Loss of Mains (Voltage/Freq/ROCOF)	SQ1B22A
	B80 - Bus [Main+1ph volt]	SQ1B80A			
	B83 - Bus [Tie +3ph volt]	SQ1B83A			
	C86 - Capacitor [4 step 2xWye banks]	SQ1C86A			

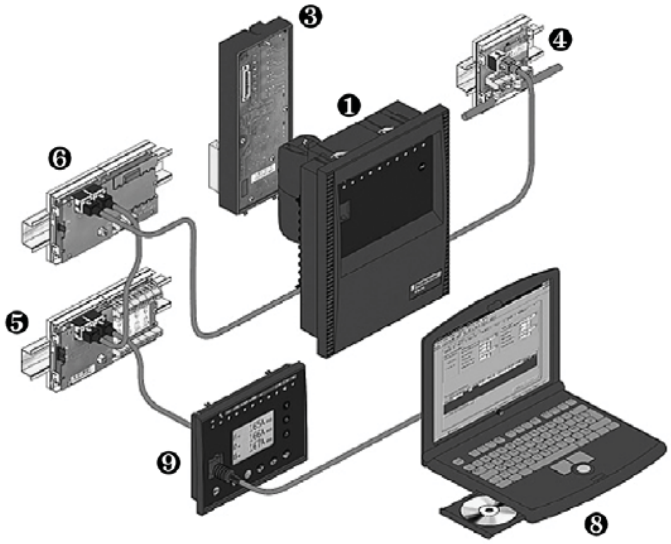
a Replace “A” suffix with “P” to select the “Pro” version mimic display.

Table 5: Series 20+40+80 Accessory List

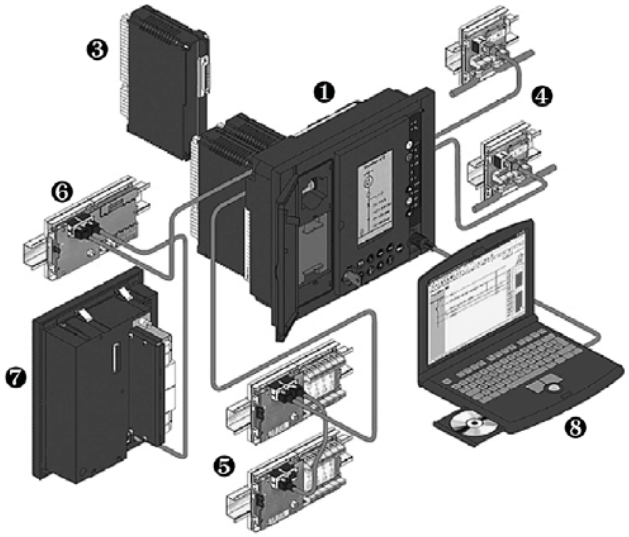
Accessory Type	Series 20/40	Series 80	Catalog No.	Description
Digital I/O Module		x	MES120	14 inputs + 6 outputs / 24-250Vdc
		x	MES120G	14 inputs + 6 outputs / 220-250Vdc/hi p.u.
		x	MES120H	14 inputs + 6 outputs / 110-125 Vdc/hi p.u.
	x		MES114	10 Input / 4 output module
	x		MES114E	10 inputs + 4 outputs 110/125V
	x		MES114F	10 inputs + 4 outputs 220/250V
Communication I/Fb Module	x	x	ACE959	RS485 4-wire Interface Module (requires. ext. 24VDC control pwr)
	x	x	ACE9492	RS485 2-wire Interface Module (requires. ext. 24VDC control pwr)
	x	x	ACE937	Fiber optic Interface Module
	x	x	ACE969TP	(2)RS485 2wire I/F
	x	x	ACE969FO	(1) RS485 2wire + (1) F/O I/F
Analog I/O module		x	MCS025	Synch check module (includes cable CCA785)
	x	x	MET1482	8 temperature sensor input module
	x	x	MSA141	Analog output module
	x	x	DSM303	Remote advanced MMI (requires cable CCA77x see below)
		x	SFT080	Logipam plc logic software
		x	AMT840	Assembly plate for surface mounting of MCS module
Analog I/O Cables	x	x	CCA770	2ft cable from remote display to base unit
	x	x	CCA772	2m cable from remote display to base unit
	x	x	CCA774	4m cable from remote display to base unit
Ground Sensor CTs (mV out)	x	x	CSH30	Interposing window CT for Residual current input
	x	x	CSH120	Ground Sensor CT - 120 mm window
	x	x	CSH200	Ground Sensor CT - 200 mm window
	x	x	ACE990	Aux. CT for Ground Sensor CT Ratio Adjustment (for retrofit)
Configure softwarec	x	x	SFT2841KIT	Setting/operating software kit (including SFT2826 osc s/w+CCA783 cable)
Selected sparesd	x	x	2640KIT	Terminal blocks for MES modules
	x	x	CCA634	1 or 5 A CT Current Connector
	x	x	CCT640	Voltage Connector
	x	x	CCA612	Cable for communication module to relay connection
	x	x	CCA783	Cable for pc to relay connection
		x	CCA785	MCS025 cable
	x		CCA670	LPCT Current Connector
		x	CCA671	LPCT Current Connector

b Includes CCA612 cable to relay rear port
c One s/w kit required per Series 80 order and recommended per Series 40/20 order
d To be ordered as spare or replacement

Sepam Series 20, 40 and 80
Selection Example



Series 20 and Series 40



Series 80

❶ Base Unit▼
❷ Parameter and protection settings saved on removable memory cartridge (Series 80 only)
❸ 42 logic inputs and 23 relay outputs, with 3 optional modules. (Series 80): 10 logic inputs and 8 relay outputs with optional module (Series 20/40)
❹ Connection to communication networks
❺ Temperature sensors
❻ Low-level analog output
❼ Synchro-check module (Series 80 only)
❽ Software tools
❾ Remote display▼

▼*Remote Display for use with "Basic" Base Units -- contact local sales office*

Table 6: Selection Example

Follow these steps:			Example:		
Selection Sequence		Type Part	QTY	Catalog No.	Description
[1]	Select from Table 4 per system, features Table 1 & 2/3	Relay unit	1	SP1T87A	T87- Transformer [Diff.-2 wdg)
[2]	Spare by application	Memory module	0	MMS020xxx	Spare memory module
[3]	Select from Table 5 (as required)	Digital I/O	1	MES120	14 inputs + 6 outputs / 24-250Vdc
[4]	Select from Table 5 (as required)	Communication module	1	ACE959	RS485 4-wire Interface Module I
[5]	Select from Table 5 (as required)	RTD Input	1	MET1482	8 temperature sensor input module
[6]	Select from Table 5 (as required)	Analog output	0	MSA141	Analog output module (1 channel)
[7]	Select from Table 5 (as required)	Sync check (25) module	1	MCS025	Synch check module (includes cable CCA785)
[8]	Select from Table 5 (as required)	Config S/W	1	SFT2841KIT	Setting / operating software kit
[9]	Select from Table 5 (as required)	Cable for RTD I/F Modulle	1	CCA772	2m cable from remote display to base unit

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Document#3000CT07018/07 August 2007

08-2007

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